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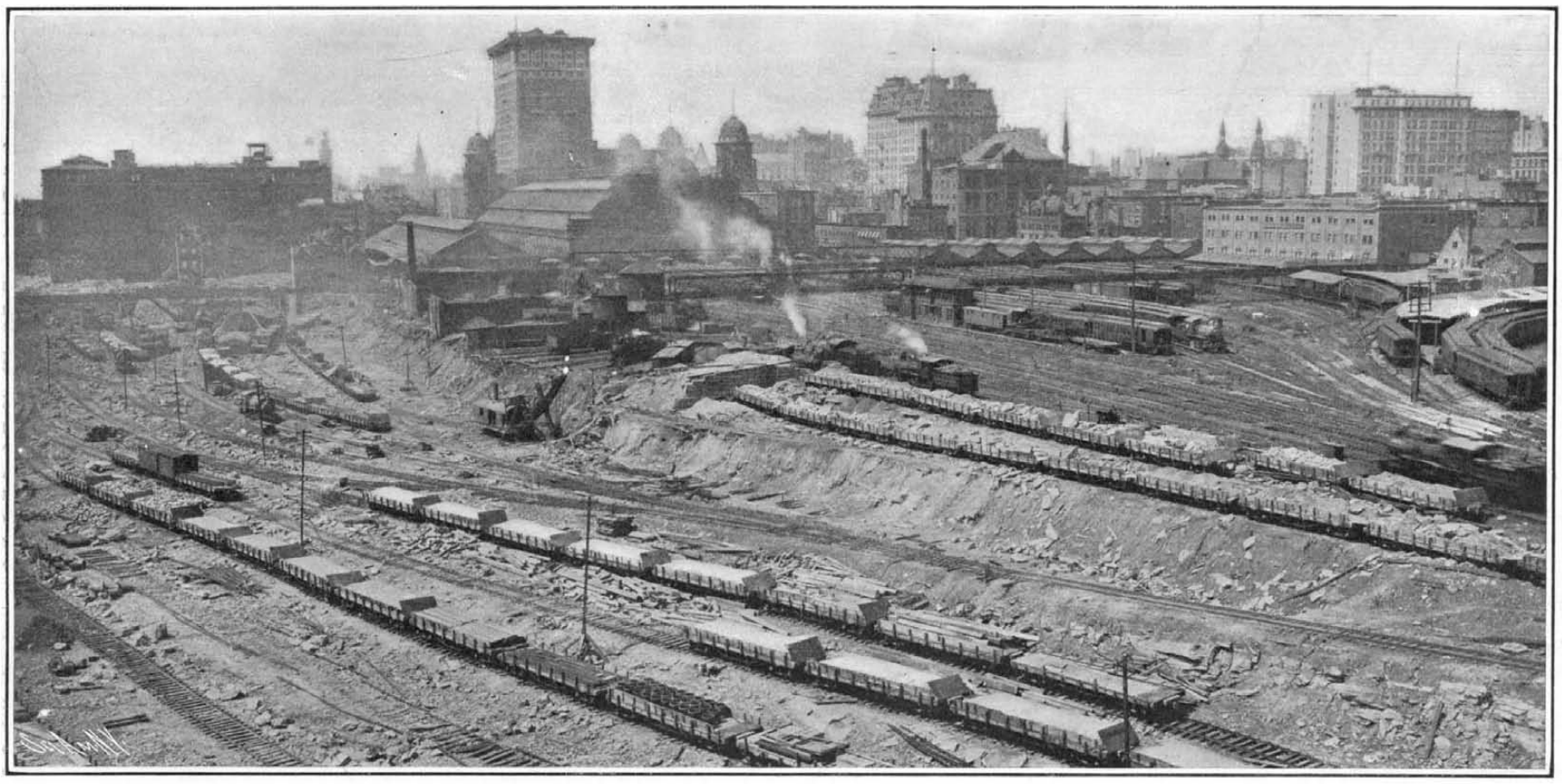
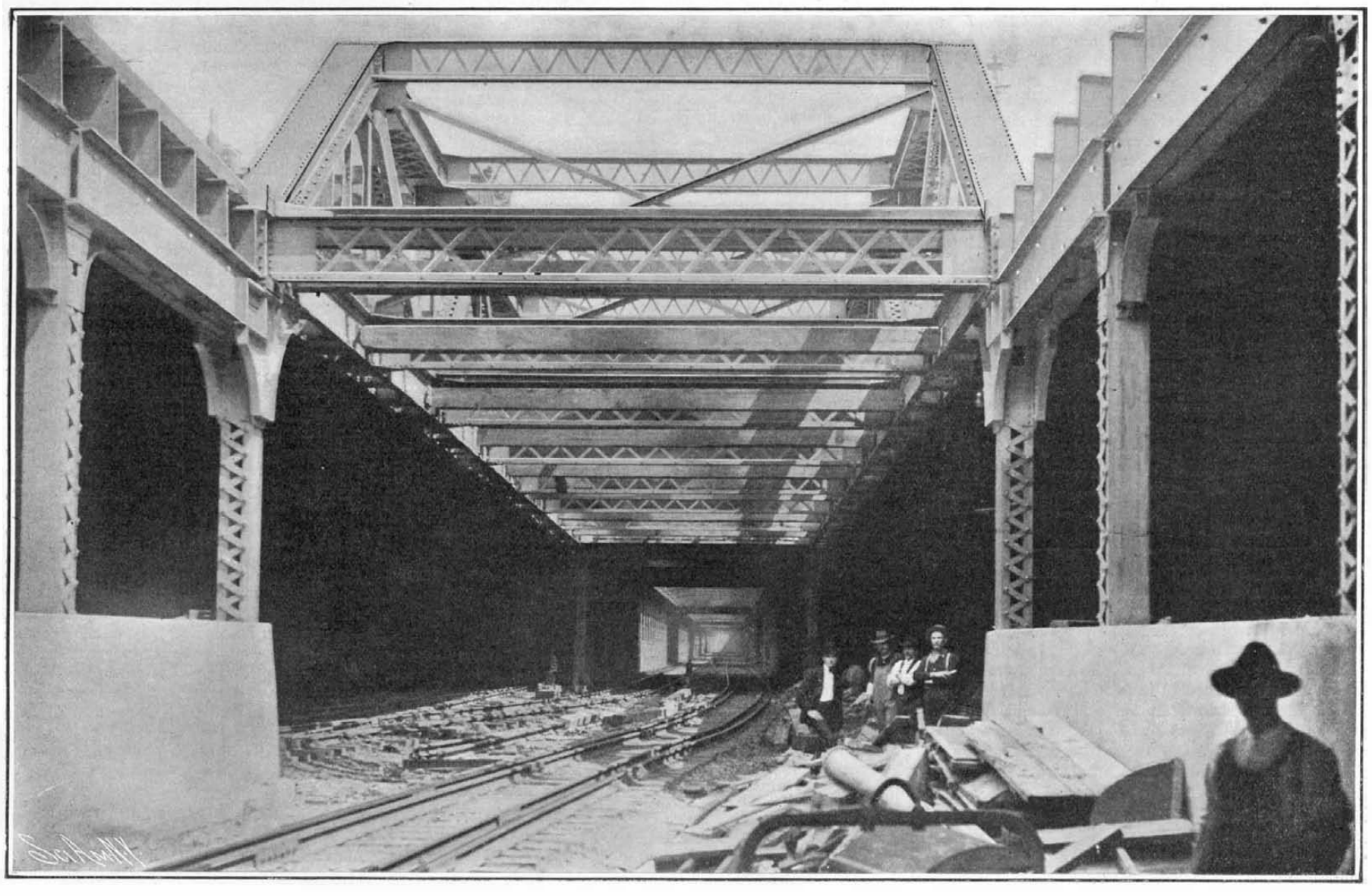


View looking southwest, showing the excavated easterly portion of the yard in the foreground, and the present yard and station to the right. The building will cover eight acres, and the yard fifty-six acres.

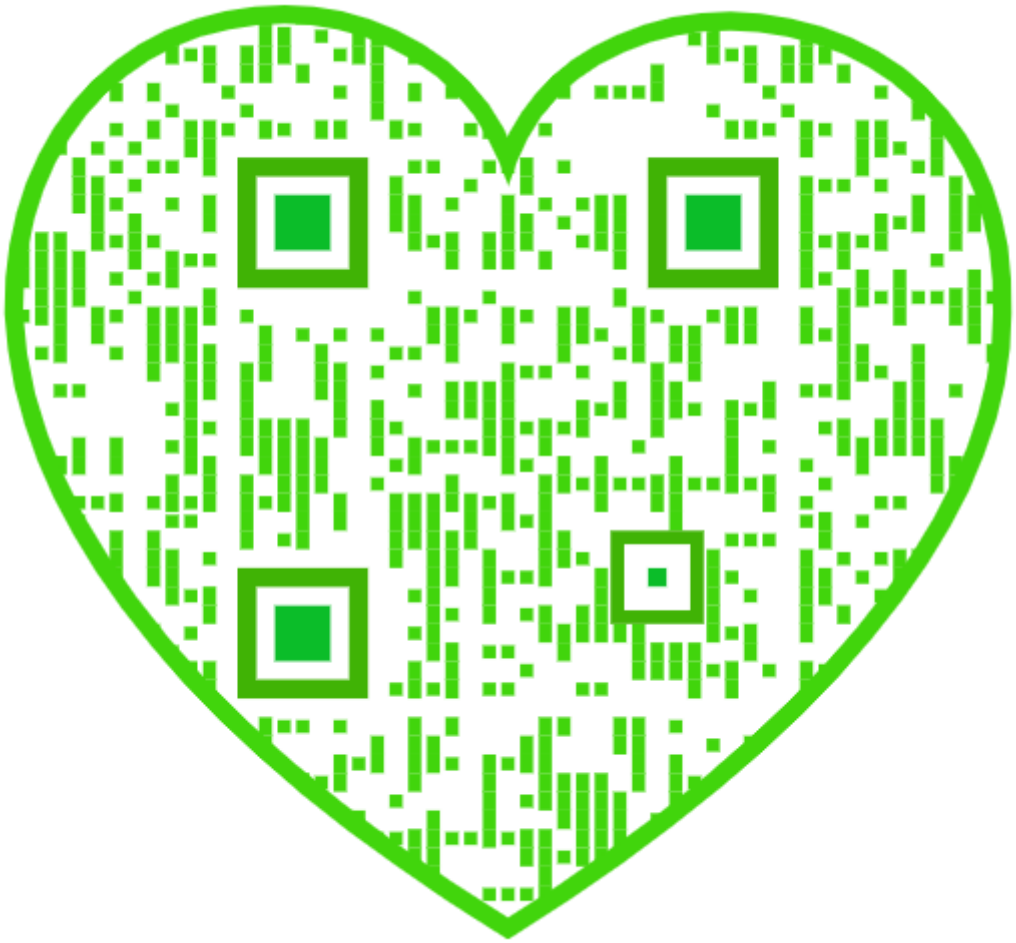
Site of the New Grand Central Station and Yard, New York.



The massive truss is put in at the point where the four tunnel tracks widen out to ten tracks, filling the whole of Park Avenue.

Looking North Through Park Avenue Tunnel at Entrance to Terminal Yard.

THE GRAND CENTRAL STATION IMPROVEMENTS.—[See page 222.]



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NEW YORK, SATURDAY, SEPTEMBER 16, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PLANNING THE PANAMA CANAL.

The Board of Expert Engineers, gathered from many parts of the world, that recently met in Washington on request of President Roosevelt, to decide upon the best type of canal to build at the Isthmus of Panama, has before it what is probably the most momentous question of a strictly engineering character that was ever passed upon in the history of the world. Upon its decision will depend the time of completion, the cost, the character, and very largely the commercial success of this great enterprise. The Board will have placed before it an enormous amount of engineering data that has been gathered through the several decades in which work has been done, either in the way of surveys or construction, upon the forty-two-mile stretch of country on which the canal is located. The mere engineering data, such as surveys, borings, topographical work, meteorological and geological observations, in themselves form a most voluminous record. These constitute the facts as distinguished from the theories, and it is upon the facts, after all, that the final plans must be built up and the final decision based. In addition to these ascertained facts, however, the advisory board will have placed before it many alternative plans, the most important, because the most complete, of which is that one drawn up by the late French Panama Canal Company and indorsed by the International Commission of Engineers. There will also be the amended plans, as favored by the Isthmian Canal Commission; the apparently somewhat hasty and ill-digested plans of the late Chief Engineer Wallace for a sea-level canal; the proposals of Mr. Bunau-Varilla, the Chief Engineer of the late French Panama Company, for the construction, at an early date, of a canal with a high summit level, with arrangements for its gradual conversion during operation into a sea-level canal. Furthermore, there is the important study of the subject which was recently defined in a pamphlet prepared by Lindon W. Bates, which proposes to create large navigable basins at each end of the canal, and to convert considerable areas of mosquito-infested and malarial swamp into fresh-water lakes.

In a letter read at the first meeting of the Board, Chairman Shonts stated that this system of presenting the subject by offering several alternative plans had been adopted, because it seemed to be the method by which all essential information could be conveyed in the most condensed form possible. He stated further that the Commission desired the opinion of the International Board not only upon these plans, but upon any variation of them, or upon any entirely different plan that might suggest itself. During the last of this month the Board will accompany the Commission to the Isthmus of Panama, to make a personal inspection of the work.

FILTRATION FOR CROTON WATER.

That filtration of the city's water supply is one of the surest means of preventing typhoid fever and kindred diseases, has been proved in every case in which filtration plants have been built and put in operation. In recent years the SCIENTIFIC AMERICAN has given much attention to the question of water supply filtration, and the records, as far as they have appeared in these columns, go to prove that of all municipal improvements, this is one of the most beneficent and immediate in the betterment of the health of the inhabitants.

The question has recently been placed before the Mayor in a letter from Dr. Darlington, the Health Commissioner of this city. He points out the impossibility of safeguarding the sources of city water supply by the absolute prevention of infection of the watershed from which the supply is drawn. As regards the Croton watershed, the region is to some extent settled already, and there are various scattered centers of population which are showing evidence of rapid growth. It has been suggested that the city might furnish these localities with sewers and pumping stations; but the cost of doing work of this kind in the thorough manner that would be necessary to make it effective would be prohibitive. Moreover, Dr. Darlington is of the opinion that complete ownership by the city of the land would not be a sure guarantee against pollution. Outside of the provision of sewers and pumping stations, or the outright purchase of the land, there is the third alternative of filtration; and it is this that the Commissioner strongly recommends. It is estimated that the first cost of sand filter beds, of a size adequate to deal with the present needs of the city, would be $17,000,000; and for this sum it would be possible to pass the whole of the supply that is now drawn from the Croton watershed through slow filtration beds, with the result that the risk of the introduction of typhoid and kindred diseases through the medium of our water supply would be practically eliminated.

Evidence of the inestimable value of filtration as a preventive of disease is afforded by the charts which accompany the Commissioner's letter. These show, in the case of Philadelphia, the low rate of typhoid fever in districts using filtered water as compared with those using water not so treated. In one district, which depended upon unfiltered water from the Delaware, the typhoid rate was high and showed wide fluctuation. In two other districts of the same city, which were supplied with water from the Schuylkill that had been passed through filter beds, a low average typhoid rate was shown, and this low rate remained practically uniform. Of the two systems of filtration that would be applicable for New York city, one employs pressure and the other depends upon gravity, the former being used where but little land is available for the filter plant, and the gravity system being used where an ample area can be obtained. In the latter system, which is the more common, water is allowed to find its way by gravity through broad, shallow beds of sand, and a considerable part of the purification is due to "beneficent" bacteria. Among the many municipal improvements that are being suggested just now for the betterment of New York city, we know of none that is deserving of more serious consideration by the authorities than this.

OUR RAILROAD SYSTEM.

Despite its vast proportions, the railroad system of the United States continues to maintain its rapid rate of growth, and the last report of the Interstate Commerce Commission shows that there are at present no indications of any such stagnation as marked the year 1893-1894. The growth is a steady and a healthy one. The total single-track railway mileage has risen to 213,904 miles, an increase during the year of 5,927 miles. These figures and those that follow represent no less than 2,104 separate railway corporations. In the service of the railways there are 46,743 locomotives, an increase of 2,872. The total number of cars is 1,798,561, an increase during the year of 45,172. Of this total, 39,752 are passenger cars, 1,692,194 freight cars, and the remainder are employed in the special service of the railroads. The work of equipping the rolling stock with train brakes and automatic couplers is in a satisfactory condition, as out of a total of over 1,800,000 locomotives and cars, over one and a half million are fitted with train brakes, and over 1,800,000 are fitted with automatic couplers. The par value of the amount of railway capital outstanding is $13,213,-124,679, which represents a capitalization of $64,265 per mile.

During the year the number of passengers carried was 715,419,682, an increase of 20,528,147, and the number of tons of freight carried was 1,309,899,165, an increase of five and a half million in the year. The net earnings of the railways amounted to $636,277,838, a decrease of $7,030,217. The amount of dividends declared during the year amounted to $222,056,595. The total number of casualties to persons on the railways for the year was 94,201, of which 10,046 represented the number of persons killed, and 84,155 the number injured. Of trainmen, 2,114 were killed and 29,275 were injured. Of switch tenders, crossing tenders, and watchmen, 229 were killed and 2,070 were injured; while of other employes, 1,289 were killed and 35,722 injured. The number of passengers killed in the course of the year was 441, and 9,111 were injured. Of these, 262 passengers were killed and 4,978 were injured in collisions and derailments. When these statistics tell us that the ratio of casualties indicates that one employe in every 357 was killed, and one in every 19 was injured, we begin to realize how serious are the risks run by those who maintain our great railroad system in constant operation. The risk to life and limb of the trainmen surely has its parallel nowhere outside of the battlefield; for we learn that in the particular year under consideration, one trainman was killed for every 120 employed, and one out of every nine was injured. This proportion of casualties, as a matter of fact, is just about one-half as great as that of the whole Japanese army during the recent war.

THE PROGRESS OF WIRELESS TELEGRAPHY IN GREAT BRITAIN.

The British government has recently issued the first annual report concerning the development of wireless telegraphy in that country during the first year since the passing of the Wireless Telegraphy Act. According to this regulation, it was made illegal to work or exploit, either commercially or experimentally, any system of ethereal communication without the sanction of the Postmaster-General. During the past twelve months, 73 applications for working wireless telegraph systems have been received. Of this number, 48 have been granted, 4 have been returned to their applicants for modification, as permissions were refused in the original form, 1 has been rejected in its entirety, while the remainder have not been proceeded with.

The solitary complete rejection is in connection with the Orling-Armstrong system. The reason for its refusal by the government was because the company controlling the patents proposed to establish wireless exchanges. Such a system would have interfered with the ordinary telegraphic business of the Post Office, which is a government monopoly. The act, however, as the report shows, is being liberally administered, and the government supervision that is being exercised cannot do else but tend to develop the system of communication, at the same time preventing any one system obtaining a monopoly either by unfair competition or merging processes. The report also shows the number of various systems that have been advanced to a practical stage, and that the Marconi system is by no means the only commercial and practical one. As a matter of fact, of the 73 applications received, only three concern the Marconi apparatus, and of these three licenses, one is purely for experimental purposes. The two other permissions extend to the Marconi company itself, and to Lloyd's, which is under contract to the Marconi company for the exclusive application of that system. These, however, are the only two companies that are exploiting the scheme upon a commercial basis in accepting wireless telegrams from the public; but the report shows that other principles are on the eve of commercial exploitation, or are being privately employed for business purposes.

The variety of the apparatus in vogue may be gathered from the fact that the Eastern Telegraph Company—a cable concern—are utilizing the Maskelyne system for communication between their cable station at Porthcurnow in Cornwall and their cable-repairing ships; the London, Brighton, and South Coast Railroad are adopting the instruments of the French inventor Rochefort for linking up their station at Newhaven with the French port Dieppe, on the opposite side of the English Channel; the Midland Railroad are installing the Lodge-Muirhead system, for communication across the Irish Channel between Belfast and Heysham; while two American companies, the De Forrest and Fessenden, have been granted licenses for the erection of stations in Scotland.

The Midland Railroad is also carrying out a series of experiments with the Lodge-Muirhead system for communication with trains in motion from a point near Derby, as has already been done in this country and Germany. The Marconi, De Forrest, and Fessenden companies have been granted permission for the development of communication between Great Britain and America. For this work the Marconi company intend to utilize the station at Poldhu in Cornwall, while they have also applied for permission to erect another similar station in Ireland for the same object, but this application has not yet been granted. The experiments of the two American companies will be conducted from the stations which they are erecting in Scotland. The De Forrest company also desires to establish a series of stations around the British coast, while the Lodge-Muirhead company has also applied for licenses at four important stations from a shipping point of view —Dover, the Isle of Wight, the Lizard, and the Fastnet.

During the first three months of this year, the British Post Office received 111 messages from the public for transmission to ships at sea *via* Marconi, in accordance with their agreement. Of this total, 21 messages failed to reach their destination. The incoming messages—from ships at sea for transmission to interior land post offices—aggregated 1,655 for the same period. The revenue from this source of traffic averages about $12,000 per annum. There are, however, only six shore stations and fifty ships at present replete with the Marconi apparatus, and it is recognized that the number will have to be considerably increased before the scheme can become profitable.

There is, however, every sign that wireless telegraphic communication has successfully emerged from its experimental stage, and can be extensively developed commercially. At present, however, progress is somewhat slow, owing to the high tariffs levied for the transmission of messages by this means; and until the fees are reduced so as to compare favorably with the ordinary telegraphic system, it will not become of the importance to the maritime and commercial community that its value deserves. It is anticipated, how-

ever, that the healthy competition between the various systems established by the British government's action will achieve this end.

THE BUOYANCY OF SUBMARINE BOATS.

In view of the tragic interest attaching to the recent submarine disasters, the following explanation of the loss of submarine "A8," given by a submarine expert during the investigation by the British Admiralty, commands special attention. The "A8" while traveling on the surface in a calm sea, it will be remembered, suddenly plunged down, and sank with fourteen of the crew.

According to Capt. Bacon, in the ordinary conditions the buoyancy of the submarine was reduced until only about 800 pounds remained, the boat being sunk until only approximately two feet remained well out of the water. In that condition the boat would dive if the horizontal rudders were put down, the nose of the boat depressed, and the speed of 6½ knots maintained. But if the buoyancy of the boat were increased to about 1,120 pounds, and she was still kept trimmed horizontally, the boat could not be made to dive. Before that happened and the boat could be forced under, her tail must rise to the surface. In such a case the propellers and rudders would no longer be immersed, and in consequence the boat would be unable to break away from the surface. If, however, she were trimmed suitably, two or three degrees by the bow, diving could be carried out. The "A8" had 13,440 pounds of buoyancy instead of 1,120 pounds, and was going 10 knots instead of 6 knots. The causes of her diving were therefore not clear. Allowing for the difference of 6½ and 10 knots, and supposing, as was probably true, that all the pressures varied as the square of the speed, the effect of speed would be only as 100 is to 42 buoyancy and one degree by the bow. If the boat steamed ahead and sank, the boat had a tendency to go more and more by the bow, and to steam herself under water. Imagine the boat to be immersed until her hull was nearly covered, whichever way the rudders were put, the conning tower would probably go under water, for the down pressure of the rudders would reduce the buoyancy more than that given her by the conning tower.

Taking for granted that a boat in this condition could be dived at 10 knots, the question was, how could the condition of the boat be changed from one of 13,440 pounds buoyancy and four degrees by the stern to one of 7,840 pounds and one degree by the bow? The only explanation was by water finding its way into the tanks forward in the boat. The two tanks into which the water could possibly get were the foremost main ballast tank and the foremost gasoline tank. If 5,660 pounds of water found its way into these, the buoyancy of the boat would be reduced to 7,840 pounds, and the moment of 75 tons would be introduced, tending to put her down by the nose. This would mean an inclination of 2½ degrees by the bow. Steaming ahead would probably bring her down another two degrees by the bow. The only other weights that could move were the men. There were six men stationed in the boat who were liable to move. Had these gone forward after the boat started steaming, as was usually the case, and sat down by the torpedo tubes, they would have produced a moment of about 12 foot-tons, or an inclination at 7,840 pounds displacement of one degree.

RAMSAY, RADIUM, AND BURKE.

In a well-considered and frankly skeptical and sensible article published in the Independent, Sir William Ramsay has this to say anent Burke's "radiobes":

"During the decomposition of the emanation into helium and other products much heat is evolved, as was shown by Prof. Rutherford; it had been shown before by the Curies that radium continually gives off heat, and Rutherford proved that by far the major part of the heat was due to the spontaneous change undergone by the emanation. Now this energy need not all be manifested as heat; some, at least, may appear as chemical action. A solution of the emanation in water decomposes the water in which it is dissolved into its constituent gases, oxygen and hydrogen. And the rate at which the water is decomposed keeps pace with the rate at which the emanation changes—that is, at the beginning, when the emanation is fresh and there is comparatively much present, the amount of gases evolved is comparatively great; and as the emanation diminishes so the decomposition decreases, less gas being produced in a given time,

"The solution of this gas in water has the curious property of coagulating white of egg or albumen. What is the precise nature of the change produced is unknown. Hence if kept in a liquid containing albumen it forms, no doubt, ultra-microscopic cells, for the gas produced is liberated in molecules, or, it may be, even in atoms. Some solution, injected under the skin of a living being, surrounds itself with a sack, or bag, the walls of which are thick and hard and are absorbed only slowly by the living organism. These phenomena require further study, and I regret to say that I have not had an opportunity of examining them more thoroughly, though I hope to do so.

"Mr. Burke made use of solid radium bromide in fine powder. He sprinkled a few minute grains on a gelatine broth medium, possibly somewhat soft, so that the granules would sink slowly below the surface. Once there they would dissolve in and decompose the water, liberating oxygen and hydrogen, together with emanations, which would remain mixed with these gases. The gases would form minute bubbles, probably of microscopic dimensions, and the coagulating action of the emanation on the albumen of the liquor would surround each with a skin, so that the product would appear like a cell; its contents, however, would be gas, or, rather, a mixture of the gases oxygen and hydrogen. The emanation, inclosed in such a sack, would still decompose water, for enough would diffuse through the walls of the sack, which, moreover, would naturally be moist. The accumulation of more gas would almost certainly burst the walls of the cell, and almost equally certainly in one or two places. Through the cracks more gas would issue, carrying with it the emanation, and with it the property of coagulating the walls of a fresh cell. The result of the original bubble would resemble a yeast cell, and the second cell a bud, or perhaps more than one, if the original cell happened to burst. This process would necessarily be repeated as long as the radium continued to evolve emanation, which would be for the best part of a thousand years. The 'life,' therefore, would be a long one, and the 'budding' would impress itself on an observer as equally continuous with that of a living organism."

LOST ARTS.

Not as much as we used to, but occasionally even yet, one hears of some wonder accomplished by the ancients which cannot be done now.

Not so many years ago it was quite commonly asserted that modern workmen could not quarry, or, having quarried, could not handle stones as large as the monoliths of Egypt; and the writer has heard a public speaker of note assert that it would be impossible to handle, with modern implements, such large stones as were used in the pyramids, or to join them as perfectly as they are joined there; yet, when occasion arose, larger stones than any of these were quarried in Maine, and some of the larger monoliths themselves were transported, not only to the sea, but across it, and erected in England, France, and America; and there are individuals to-day who might, if they chose, cause the transportation to and erection in this country of the largest pyramids, or build new ones ten times larger and more durable. Pyramids are not being generally built, nowadays, because they are not in line with the trend of modern ambition; that's all.

It is very doubtful if a "Damascus blade" would stand half as severe usage as a modern band-saw blade, or even as much as the spring of a forty-cent clock; while the ornamentation of those wondrous blades, so far as the mechanical execution is concerned, can be excelled by apprentices and amateurs of to-day.

Of the "lost art" of hardening copper little is heard of late years, though one occasionally hears a wiseling from the wilds wish that he knew how to do it as well as the ancients; and, while it is perhaps regrettable that he doesn't, his ignorance is his own fault.

Many arts and devices have been abandoned because new knowledge has made them useless, and time spent in rediscovering them would be worse than wasted. The modern youth had much better spend his time studying the art of his contemporaries than that which is "lost."

THE CURRENT SUPPLEMENT.

The Truckee-Carson reclamation project, which will convert 30,000 acres of parched land in Nevada into luxuriant verdure, is fully described by Enos Brown in the opening article of the current SUPPLEMENT, No. 1550. William Barclay Parsons presents his views on rapid transit in great cities. Inasmuch as he was the engineer who gave us New York's Subway, his observations are of considerable importance. The report of the Royal Commission on coal supply has made it clear that in the future England will have to generate power by other means than from coal if she is to keep her place as a manufacturing nation. In a well-considered article Mr. James Saunders shows how tides could be made to turn factory wheels. T. P. E. Butt discourses interestingly on the induction motor as a generator. Mr. Warren R. Smith gives some excellent directions for a number of experiments with dyes. The Plauen viaduct, known locally as the Syrathal viaduct, because it bridges the valley of the Syra, was finally completed during the early part of this year. It comprises the largest arch masonry ring in the world, measuring, as it does, 295 feet 3 inches between the abutments. This stupendous work is very fully described by our English correspondent. Sir William White presents another installment of his treatise on submarines. An article on Sakhalin gives a very detailed account of the island which proved such a bone of contention between the Russian and Japanese plenipotentiaries. Prof. E. P. Schoch presents a thoughtful paper on the physical notions of entropy and free energy and their importance in general chemistry.

SCIENCE NOTES.

The pedagogical dictum, "from the concrete to the abstract," finds universal acceptance in this age of laboratory education. The idea of teaching through hand and eye in manual training is being put into practice more and more, owing to the great success that has been achieved by the pioneer institutions in this line. Why should not the same principles of co-ordinate activity govern in the teaching of algebra? Can we not clear up some of the most troublesome points by making visual, concrete representations of negative numbers, and of equations?

After covering an ebonite dish containing 0.03 gramme of radium bromide with an aluminium plate 0.1 millimeter in thickness, M. N. Orloff has noticed on the surface of the aluminium turned toward the radium protuberances similar to small drops of melted metal, but not differing in appearance from that of the neighboring surface of aluminium. These protuberances are radio-active and produce a photographic image through black paper in a few minutes. They appear to have emitted invisible radiations during a period of six months without noticeable abatement. The inference is that there is a formation of a stable alloy, due to the accumulation of particles proceeding from the atomic system of the radium around slight nuclei of aluminium.

The Chemiker Zeitung describes the researches of Dr. H. Thorns on the obnoxious products of tobacco smoke, nicotine, and its products of decomposition, ammonia, methylamine, pyrrol, hydrogen sulphide, cyanhydric acid, butyric acid, carbonic acid, carbon oxide, watery vapor, pyrogenous essential oil, tarry and resinous products, among which the presence of a small quantity of phenol has been ascertained. He recommends the filtration of the smoke through cotton soaked in ferric salts. The preparation is obtained by dissolving one part ammoniacal sulphate of iron in four parts of distilled water and 1-10 to 1-5 of a part of glycerine, soaking of the wadding and its desiccation, which ought to leave 50 per cent of the salt. By this process the fumes of the essential oil, of the hydrogen sulphide, the cyanhydric acid and about half of the nicotine and its products of decomposition, as well as the greater part of ammonia, are got rid of, while not depriving the smoke of its aroma.

A Unique Process of Irrigation.—The Italian professor, Cusmano, has originated a process which assures an ample supply of water to plants growing in regions where the dry season is of long duration. Use is made of the Barbary nopal, the *Opuntia vulgaris*, a fig tree which is widely acclimated and bears figs that are excellent reservoirs of moisture. In spring a ditch, 30 centimeters deep and about 2 meters in diameter, is dug at the foot of the tree that is to be protected from the drought. This ditch is filled with the figs cut into pieces about two fingers thick; to make a dense layer, they are beaten down and stems are added as the mass piles up. This mucilaginous pulp, covered with a layer of earth, stores up much water and gives it out gradually, thus watering the tree a long time. Prof. Cusmano asserts that after four months of drought he has found pulp still fresh, capable of supporting vegetation, and the foliage was in perfect condition.

M. Berthelot has directed his researches to the white glass of ordinary test tubes, which commences to soften at 550 deg. C., and to the Jena glass, which softens only at 700 to 750 deg., and has communicated his conclusions to the Académie des Sciences. Glass kept for a long time at a temperature a little lower than its fusing point becomes opaque, and is devitrified. Softened silica is also at length modified. It is affected more rapidly when heated by the acetylene blowpipe, of which the temperature is sufficiently high for volatilization. The permeability of glass as well as that of softened silica is like that of membranes manifesting osmotic properties. It does not result from the existence of visible holes and fissures. The penetration especially occurs when the silica and glass are softened by heat and thinned by a pressure of interior gases greater than that of the atmospheric pressure. The intervention of this permeability in the current phenomena of chemistry and physics has so far scarcely been suspected. Hereafter, the penetration or dissipation of gases, interior or exterior to vessels regarded as sealed, such as hydrogen, oxygen, nitrogen, helium, and the emanations of radio-active bodies, must be surmised whenever vessels of glass, silica, earthenware, or porcelain, have been raised to a temperature near their point of softening, which occurs in organic analysis, in the reduction of metals by means of hydrogen, in the measurement of high temperatures by means of gas thermometers, and in the determinations of the density of vapors.

THE TRUCKEE-CARSON IRRIGATION PROJECT.

BY HERBERT I. BENNETT.

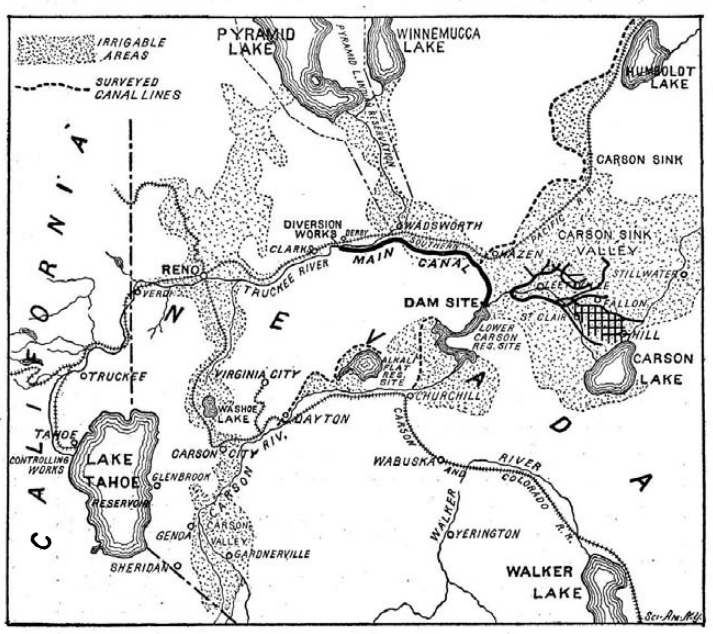
ONSIDERED apart from the fact that it was Bunker Hill Day, June 17, 1905, was an occasion of great moment to the interests of the State of Nevada, for then it was that the immense government irrigating canal known as the Main Truckee Canal, forming part of the Truckee-Carson Project, received its first water from the Truckee River, out in the western portion of Nevada.

The Truckee-Carson Project deals with the utilization, for the irrigation and reclaiming of the adjacent desert region, of the large volume of water flowing to absolute waste through the rivers of western Nevada.

Main Diverting Dam.—The top of the main diverting dam on the Truckee River, 24 miles east of Reno, on the Central Pacific division of the Southern Pacific Railroad, is 4,219 feet above sea level. This dam is 155 feet long between abutments, and at the north end of the dam proper is an earth embankment about 1,000 feet in length extending across the low grounds to the base of the hills and the railroad track. The main diverting dam, composed of fifteen piers, each five feet thick, at right angles to the course of the stream, divides the structure into sixteen openings, or bays, each of which is five feet in width. Each opening is closed by a cast-iron gate comprising two leaves, each being five feet in depth. The regulating gates diverting the water into the Main Truckee Canal are built immediately adjacent to and as a part of the main diverting dam. These gates comprise nine gates of the same type and are operated by the same means as those in the main diverting dam, but the piers separating them, and the arches spanning the openings, are of concrete reinforced with steel girders, the purpose being to diminish the width of the structure. The top of this main diverting dam is 21½ feet above the floor of the outlet gates. The total cost of the concrete main diversion dam and the 31-mile Main Truckee Canal was $1,250,000.

Main Truckee Canal.—The definite location of the Main Truckee Canal, designed to convey water from the Truckee River at the main diversion dam, above described, a distance of 31 miles to the Carson River, was begun in April, 1903. The Main Truckee Canal has a capacity for the first six miles of its course of 1,400 cubic feet per second, and for the remainder of its course of 1,200 cubic feet per second. Thirteen feet will be the uniform depth of water, and the top of banks is 2 feet above the high-water line. The width at the top varies from 24 to 63 feet, the narrow part being lined with Portland cement concrete, and having a heavy grade. Nearly two miles of the canal, exclusive of tunnels, are lined with cement, this being done to reduce the sectional area by diminishing the friction in the heavy rock cuts. Three tunnels lie along the Main Truckee Canal, all of which are concrete lined throughout. The grades of the canal vary from 1 foot in 7,000 feet in the earth sections, to 1 foot in 3,000 in the concrete-lined portions. There are two wasteways, designed for the purpose of emptying the canal quickly in the event of accidents to it, discharging the water back into the Truckee River. Two spillways are located along the canal. In the event of the water getting above a certain depth, the spillways are so arranged as to throw the overflow back into the Truckee River.

Purpose of Main Truckee Canal.—The Main Truckee Canal permits of the union of the Truckee and Carson river waters in the valley of the Carson Sink, where below the Lower Carson Reservoir there are fully 175,000 acres of irrigable sage-brush lands, while there are at least 125,000 acres more at higher elevations, which can be supplied with water from the canal directly. The Main Truckee Canal will discharge its water into the Carson River at the site of the Lower Carson Reservoir, about nine miles west of Leetville, in Churchill County, Nevada. Thence the water flows in the channel of that stream about four and a half miles to the diversion dam at the head of the distributing system. This dam is 225 feet in length, with 23 gates, and is built of concrete and of the same general type as the main diverting dam at the head of the Main Truckee Canal, already fully described, and it directs the water into two main distributing canals on either side of the river. The canal on the south carries 12 feet of water, the capacity being 1,500 cubic feet per second. The north canal carries 6½ feet of water, with a capacity of 450 cubic feet per second. These two canals are at present completed for a total length of 38 miles, but with their main branches will eventually attain a total length of over 90 miles, while the laterals and drain ditches to be constructed in Carson Sink Valley alone will aggregate fully 1,200 miles. About 250 miles of these have already been finished, and are ready to distribute water to 50,000 acres of land. The extensions of this system in the Carson Sink Valley, completing the initial item and bringing under irrigation not less than 200,000 acres of land, will increase the total expense to about $2,700,000 and consume some two years' time. Further extensions of the Truckee-Carson Project to a total area of approximately 375,000 acres of land, involve the construction of expensive storage reservoirs and costly high-line canals. This work has been planned, however, and as the lands to be immediately watered are being rapidly taken by homeseekers, funds for the completion of the work will be provided by the payments to be made on the water rights therefor. It is estimated that the entire undertaking can thus be completed within nine years at an approximate total cost of $9,000,000. The soil is sandy loam and ashy in the main, and is well adapted to alfalfa, all forage crops, potatoes, onions, beets, and other vegetables; apples, pears, berries, and other hardier deciduous fruits. In the lower part of the Carson Sink Valley the soil is heavier, containing an admixture of clay. It is all valley land, covered with sagebrush and greasewood.

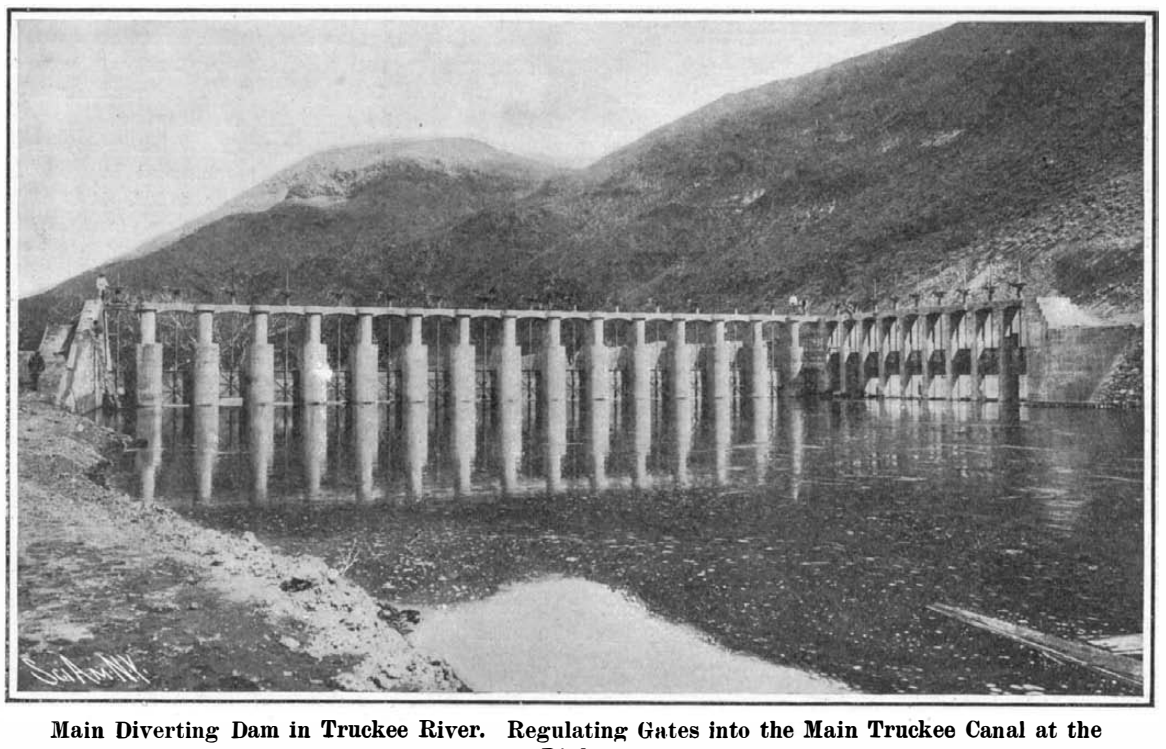


The Truckee-Carson Irrigation Project.

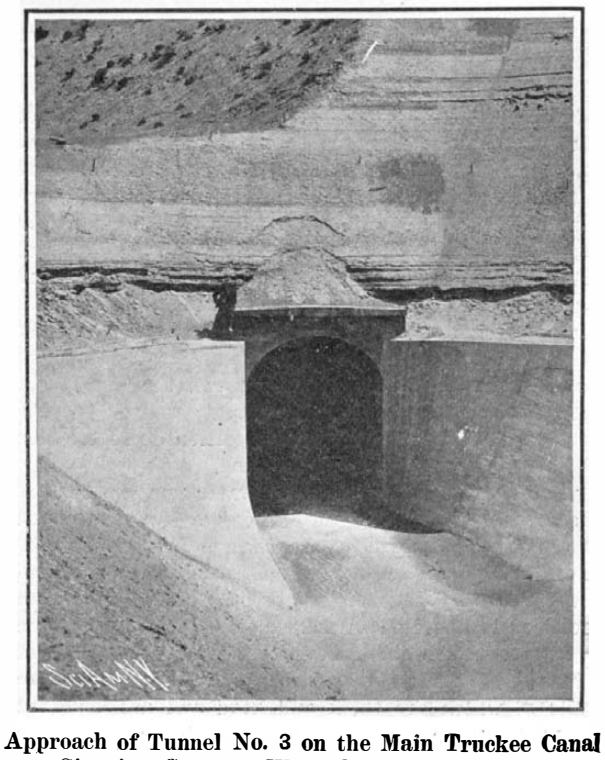
Drainage of Irrigated Lands.—The drainage of irrigated lands is a most important factor. It is necessary to prevent the concentration of alkali at the ground surface and to obviate waterlogging of the soil. The drainage system of the Truckee-Carson Project has increased the cost of the work from $5 to $10 per acre, but the prosperity of the settler depends upon the one about as much as upon the other. Title to the public lands is not given until all payments for water have been made, and lands held in private ownership are supplied with water as desired at the same price and upon the same terms as public lands. The public lands are now open to entry under the Homestead Act, no price being charged for the land, but the cost of irrigation will be assessed against the land as a charge for the water right, to be repaid in ten annual installments without interest, at the rate of $2.60 per annum per acre. This covers the cost of maintenance and operation during the ten-year period and provides for the delivery of water to each farm, and also for a comprehensive drainage system. At the conclusion of the ten-year period, the land and water rights belong to the holders of the land forever, with no further charge by the government. The care and maintenance of the irrigating system then passes into the hands of the landowners, under laws designed for their protection against corporate or individual greed and fraud.

Reclamation Service Plans.—The present plan of the United States Reclamation Service contemplates the diverting of the flood and waste waters of Truckee River, which cannot be controlled, into Winnemucca Lake. It is believed that these waters will be sufficient to keep this lake fresh, but it is certain that they would not suffice to maintain both Pyramid and Winnemucca Lakes, nor would they suffice to prevent the material reduction of the former lake, which has an area of over 235 square miles, and it is understood has been sounded to a depth of about 1,500 feet.

Care of Indians.—Regarding the government care of Indians at Pyramid Lake, in 1904 Congress passed an act providing for the allotment to each and every Indian residing on the Pyramid Lake Indian Reservation of five acres of land, which shall be supplied with water from the government irrigation system, the remaining agricultural land on the reservation controlled by the government canals to be disposed of at a price that will yield a sum sufficient to pay for water rights for the lands thus allotted to the Indians. It can thus be seen that the Indians will not suffer, even though Pyramid Lake does dry up on account of its main artery, the Truckee River, being diverted from it into the



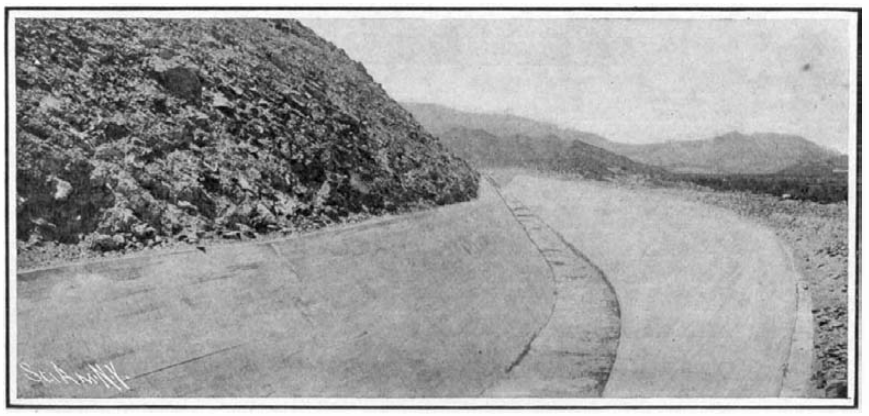
Main Diverting Dam in Truckee River. Regulating Gates into the Main Truckee Canal at the Right.



Approach of Tunnel No. 3 on the Main Truckee Canal Showing Concrete Warped Surface. Length of Tunnel, 1515 Feet.

irrigating canals. It is estimated that it will require over 400 years for Pyramid Lake to dry out, taking its present area and depth as a basis upon which to figure. When the lake runs dry, if it ever does, the Indians will have water from the irrigating system. Therefore there is no cause for alarm over the care of the Indians in the event of Pyramid Lake drying up.

Storage Reservoirs.—Lake Tahoe is one of ten storage reservoirs to be utilized in connection with the Truckee-Carson Project. The elevation of this lake's surface is to be controlled by means of regulating gates placed in the lake outlet, within a range of six feet between extreme high and low water level, this range being about 1½ feet less than the observed extreme range under natural conditions. It is conservatively estimated that by this regulation not less than 200,000 acre feet can annually be drawn from Lake Tahoe for irrigation purposes. The writer of this article is indebted to Mr. L. H. Taylor, engineer of the United States Reclamation Service in charge of the Truckee-Carson Project, for all data covered in the description of the work. Mr. Taylor took the writer over the Main Truckee Canal, explaining the operations carefully during the trip.



A Section of the Concrete-Lined Portion of the Main Truckee Canal.

Musical Insects.

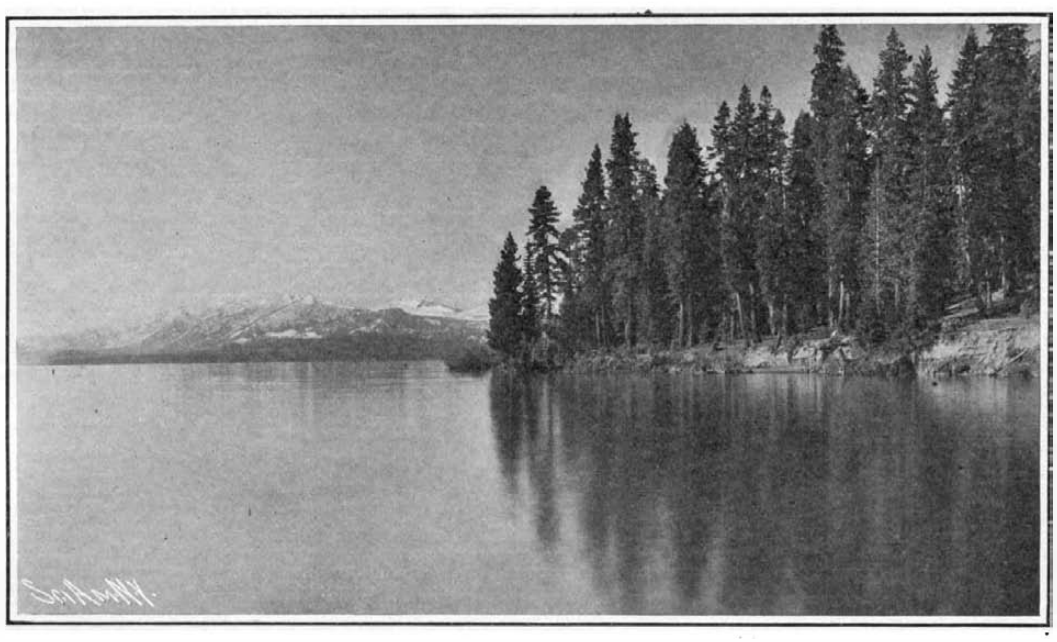
A poet, having once occasion to speak about crickets and grasshoppers, very happily termed them "violinists of the fields," and although at the time he was ignorant of the fact, he stated nothing more than a scientific truth which has recently been demonstrated by exhaustive investigations. Hitherto, naturalists have been devoting a little too much time to the study of actual sounds emitted by insects, rather than the methods by which the musical notes in question were really produced. It is now well known that the throat of insects has nothing to do with the production of such sounds, but that, on the contrary, they all use a kind of "instrument" with which Mother Nature has endowed them for the purpose. Microscopic examination has revealed the fact that in most cases this instrument has a striking resemblance to a rudimentary violin, at least as regards its principle.

Musical insects of the winged type may be divided into two groups: (1) Those which do not use their wings, and (2) those which do, for the production of sounds. Of the two, the latter species is by far the more numerous. A very curious fact in this connection is that all insects are tenors, deep bass voices being quite unknown; in addition to this, the males are always the performers, female insects being dumb—contenting themselves with stopping at home and looking after the children, instead of standing at the front door, singing like their lords and masters. Many insects sing by day, such, for instance, as the chickadee, which, however, are not of the "violinist" type, as they play upon a series of hard plates attached to the abdomen, much in the same way as a Spanish dancer uses the castanets. Another insect of this type is the black field cricket, which has its home in a small cave-like dwelling it prepares in the earth.

Other insects only sing by night, such, for instance, as the domestic and tree crickets, whose regular modulated notes are known to every one. The apparatus used by these insects exactly resembles a violin, the abdomen being partially endowed with small bridge-like edges or ridges against which the wings are rubbed, thus producing the strident note characteristic of the insect. Other insects, such as locusts and their kin, have veritable bows covered with fine ridges and attached to the wings by two button-like growths. Others have cavities covered over with a fine membrane which serve the office of resonators; in almost all insects of this type there is a parchment-like part of the abdomen which acts as a kind of sounding-board. Strange to say, many of these harmonious insects are deprived of hearing; crickets, however, are an exception, as they have sharp ears and cease their vocal efforts at the sound of approaching footsteps. Some insects, although apparently deprived of any means for the production of sounds, are none the less capable of making a noise in the world. A notable instance of this is to be found in a locust rejoicing in the euphonious name of *Microcentrum tetinervis*, which produces a short, monotonous note like two pieces of metal or flint rubbed together.

So far the field of insect voices has not been widely explored. It would be interesting to study them from the point of view of musical notation, and also to determine whether their song alters in any way according to season, hour of the day, age of the insect, and meteorological conditions.

Now is the time for those who are interested in this still unexplored field to keep ears and eyes open, for does not the cricket sing in the fields in the genial summer months? The proper study of mankind is man, we are told, yet methinks time would often be better employed in studying some of the members of the humbler walks of life upon which the Creator has showered just as much love and attention, in many cases to better purpose and a truer "at-one-ness" with Nature than can be found in man.

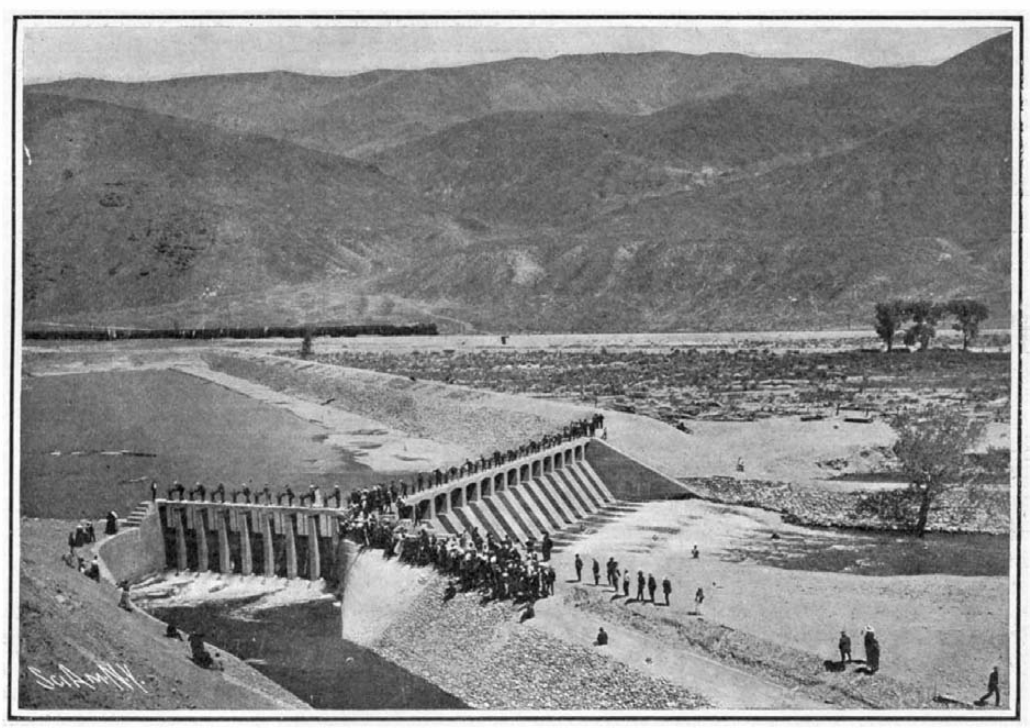


Lake Tahoe in California and Nevada. Elevation, 6,225 Feet. One of the Storage Reservoirs to be Used in Connection with the Truckee-Carson Project.

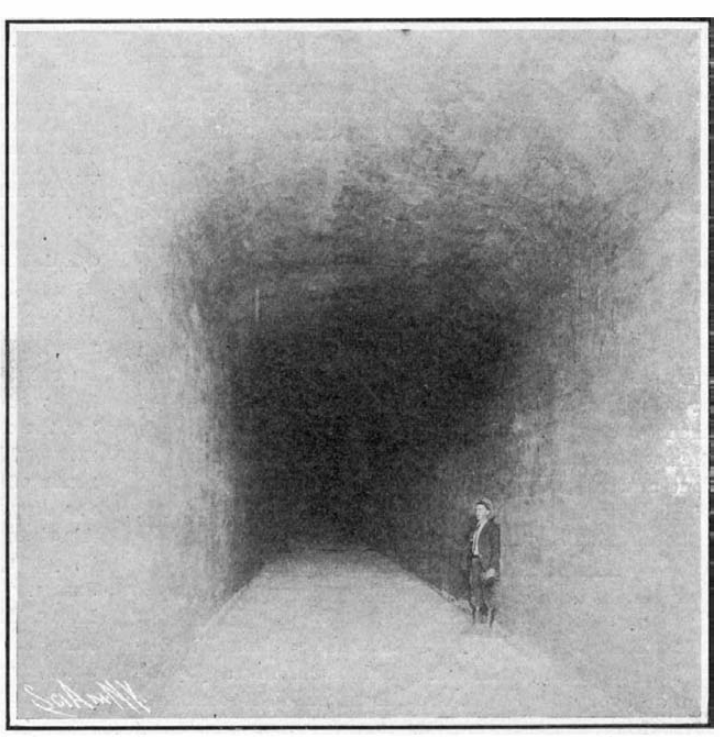
Proposed Improvements in Submarines.

The English naval department is carrying out experiments with a new type of periscope for submarines. The accident to the submarine "A1," which was run down by a liner and sunk, demonstrated the deficiency of the existing instrument, which renders only an arc of the surrounding sea visible. With the latest type, however, the whole circle of the surface is rendered visible. The Admiralty also propose to test various methods of eliminating the foul air from the interior during a long period of submersion. When the craft is submerged the noxious gases, owing to their density, settle to the bottom of the craft. It is proposed to experiment with fans for maintaining a constant circulation of the atmosphere within the boat, and to eject the noxious foul gases by jets of compressed air. These in combination will, it is anticipated, enable the unhealthy fumes to be passed through the exhaust pipe leading out through the deck abaft the conning tower and thus leave the interior constantly sweet and healthy.

Destruction of the Worms Which Attack Old Woods.—Mix 8 grammes of corrosive sublimate with 100 grammes of alcohol. Put the solution in the wormholes, and stop them with wax or gum lac of the color of the wood.—Formulaire.



Formal Opening of the Truckee-Carson Project, June 17, 1905. The Main Dam is 4,219 Feet Above the Sea Level.



Interior of Tunnel No. 3 on the Main Truckee Canal, Showing Concrete Lining.

THE TRUCKEE-CARSON IRRIGATING PROJECT.

Drouillard's Drifter Balloon Float.

The drifter balloon float is an ingenious and very simple apparatus which is used to carry from a vessel in distress to land, and *vice versa*, a rope by means of which the passengers and crew of the vessel can be rescued.

It is formed by a specially-shaped balloon, which presents to the wind a plain surface 1.8 meters long, 1.3 meters high, and 1.2 meters wide at base (71, 51, and 47 inches). This balloon tows an apparatus formed by two pieces of timber joined to form a right angle, of which the vertical beam is 2 meters long and 0.55 meter high (79.7 and 21.6 inches) and the horizontal piece 1.2 meters by 0.3 meter wide (47 by 11.8 inches). In order that it may be maintained in a proper position, there is lead attached to the under side as ballast. This "drifter" again tows a rope 1,500 to 2,000 meters (4,918 to 6,560 feet) long, which is to be used as a pass rope between the vessel in distress and the land.

The drifter is connected with the balloon float by a regulating arrangement by means of which, before the drifter is thrown at sea, an angle from 60 deg. to 90 deg. from the direction of the wind is supposed to be obtained.

The balloon float is composed of three wooden or light metal hoops, covered with a special tissue. When not in use it folds up like an accordion and occupies a very small space.

The apparatus as used for experiments is covered with cotton cloth, but when in practical use it is to be covered with strong sail tissue in order to be able to stand heavy seas and contact with the rocks when landing. To use it one draws the folds apart and it inflates itself automatically; the valve is then closed and the balloon is fastened to the drifter. The inflation can be completed, if necessary, by various means indicated by the inventor; its weight is 7 kilogrammes (15.4 pounds).

When not in use the drifter is folded up into four parts by means of hinges and occupies a very small space. When in use its four parts are maintained open by two hooks and an iron bar; the required angle is then regulated by means of the webfoot (*patte d'oie*), the line employed as a pass rope is attached, and the whole apparatus is thrown into the sea. The weight of the drifter is about 30 kilogrammes (66 pounds).

The balloon float then draws the drifter to a distance with a speed and strength proportionate to the force of the wind, for the stronger the wind the more efficacious the appliance; the drifter steers it like a rudder.

On the arrival of the line carrier either on board the ship in distress or on the shore, it is drawn out of the water. If ashore, the person who receives it draws out the iron rod which maintains the vertical piece of timber on the horizontal one, and discloses a steel hammer weighing 3.5 kilogrammes (7.7 pounds) and an iron stake of the same weight, which are incased in the vertical timber. The stake is then driven into the soil, the towed line solidly fastened to it, and a connection is thus established between the land and the ship in distress.

The balloon float is provided externally with loops and strings, to which, in case of collision or foundering of the ship, 18 to 20 persons can cling and there wait for help. They may be carried to land by the balloon float.

On September 17 and 18, 1902, a small model apparatus drifted against the wind at an angle of 120 deg. in the course of trials carried out in the roads of Royan in the presence of deputies and prominent persons.

During the trials which took place at La Pallice-Rochelle on the 19th of September, 1903, the inventor proposed to carry a rope from land to a ship in distress (a buoy was moored instead of a ship). The apparatus, set at 90 deg., was thrown into the sea from the north lighthouse at La Pallice, and, in spite of a contrary current of about 2 knots, passed within 6 meters (19.7 feet) of the buoy, at a distance of 400 meters (1,312 feet) from its starting point, making an angle of 90 deg., the time occupied being only thirteen minutes. The wind was light (6 meters, or 19.7 feet, per second) and east-northeast, while the direction taken by the apparatus was north-northeast.

Many prominent persons were present at this experiment and warmly congratulated the inventor.

The invention should prove to be a very useful one on account of its simplicity and practicability.

Statistics of Cities Having a Population of Over 25,000 in 1902 and 1903.

The Bureau of the Census has just published Bulletin 20, presenting statistics of cities having a population of over 25,000. This bulletin contains comparatively few statistics relating to the population living in these cities, but is for the most part a compilation of data relative to the resources, transactions, plant, and machinery of the municipal corporations, forming a sort of statistical inventory and balance sheet.

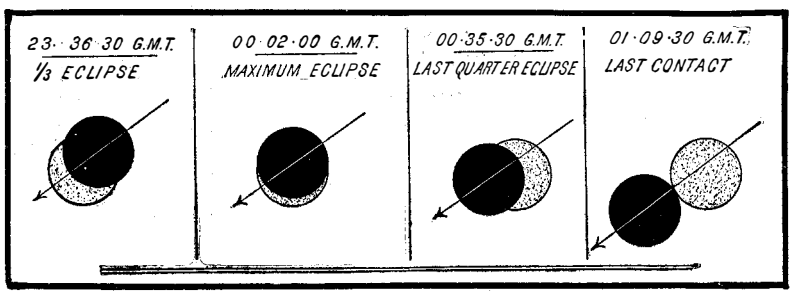
One finds in these tables such facts as the length (in miles) and the area (in square yards) of the paved streets classified with reference to kind of paving; miles of sewer; number of street lamps; miles of street railway track; number of school buildings and number of teachers and pupils; the number of public libraries with the number of volumes they contain; the number of almshouses and orphan asylums with the number of inmates; the number of policemen, and the number of arrests they have made; the number of firemen and fire engines, the number of fires occurring during the year, and property loss from such fires; the number of marriages recorded in the office of the city or county clerk and likewise the number of divorces. There are also tables showing the total population of each city, and the deaths and death rates from each of the principal causes of death.

But by far the greater part of the tabular matter consists of financial statistics presenting the expenditures and receipts of each city classified by departments and offices, the public debt, sinking funds, etc. By reference to these tables one may readily compare the cost of government and of the several departments of government in different cities.

In the aggregate the financial transactions of the 175 cities included in this report equal in magnitude those of the national government. The total corporate receipts for these cities amounted to $541,624,203, while the revenues of the United States government in the fiscal year 1904, exclusive of postal revenues, were $540,631,749. The total corporate expenditures of the cities were $535,804,200; the expenditures of the United States government were $582,402,321. The national debt in 1904 amounted to $895,157,410; the aggregate debt of the 175 cities, exclusive of sinking fund assets, was $1,134,578,783. The receipts, expenditures, and debt for the city of New York represent about one-third of the city totals.

OBSERVATION OF SOLAR ECLIPSE AT SEA.

By the courtesy of Mr. Vernon H. Brown, of the Cunard Company, we have been favored with the following observations of the solar eclipse of August 29 to 30, as taken on board the R. M. S. "Lucania" by Capt. J. B. Watt. The accompanying diagrams, drawn at the time, show the apparent path of the moon across the sun's surface, and the apparent positions of the sun and moon at the times given. The observations were taken during a westward passage.



THE ECLIPSE OF THE SUN AS OBSERVED ON THE "LUCANIA."

Correct G. M. T.	Position. Lat. N.	Position. Long. W.	Correct A. T. S.	Distance between limbs. ⊙ D.	Correct time interval.
H. M. S.			H. M. S.		M. S.
23 36 30	48° 41½′	46° 50′	20 28 29	10′ 30″	25 30
00 02 00	46 37	46 53½	20 53 25	03 50	33 30
00 35 30	46 32¼	47 19¾	21 25 20	13 00	34 00
01 09 30	46 28¼	47 30	21 58 50	31 45	.. ..

Sun's diameter = 1·0. Magnitude of Eclipse = 0·879.

Sun obscured by clouds until 23 h. 36 m. 30 s. G. M. T. when distance between limbs was 10′ 30″.

Maximum Eclipse occurred at 00 h. 02 m. 00 s. G. M. T. when distance between limbs was 03′ 50″.

Last contact occurred at 01 h. 09 m. 30 s. G. M. T. when ⊙ diameter was 31′ 45″.

Interval between Maximum Eclipses and last contact 01 h. 07 m. 30 s.

Official Meteorological Summary, New York, N. Y., August, 1905.

Atmospheric pressure: Highest, 30.24; lowest, 29.67; mean, 29.99. Temperature: Highest, 88, date, 11th; lowest, 57, date, 28th; mean of warmest day, 82, date, 11th; coolest day, 62, date, 16th; mean of maximum for the month, 78.8; mean of minimum, 65.6; absolute mean, 72.2; normal, 72.6; deficiency compared with mean of 35 years, —0.4. Warmest mean temperature for August, 77, in 1900. Coldest mean, 69, in 1903. Absolute maximum and minimum for this month for 35 years, 96 and 51. Average daily deficiency since January 1, —0.4. Precipitation, 5.23; greatest in 24 hours, 1.81, date, 15th and 16th; average of this month for 35 years, 4.61. Excess, +0.62; deficiency since January 1, —1.09. Greatest precipitation, 10.42, in 1875; least, 1.18, in 1886. Wind: Prevailing direction, south; total movement, 7,177 miles; average hourly velocity, 9.6 miles; maximum velocity, 37 miles per hour. Thunderstorms, 6th, 8th, 10th, 13th, 15th, 16th, 24th, 29th, 30th. Clear days, 8; partly cloudy, 12; cloudy, 11.

The "Mizpah Ledge"—A Tonopah Miner's Experience.

BY H. C. CUTTING.

After completing a compilation of the statutes of Nevada in 1900, my health became very much impaired by the long strain of office work, so that I decided to turn my attention to prospecting and mining. Going south from Reno into Esmeralda County, a locality which was very familiar to me, I first heard of the discovery of Tonopah on arriving at Hawthorne, the county seat, a small town set right out in the desert, whose perspective on all sides was only a barren waste of sand and sage brush, with a background of precipitous mountains. At Sodaville I heard a great deal of talk of the new find, which was about sixty miles east by south of that place. I learned that the discovery was made by Jim Butler, whom I knew quite well by correspondence, as Jim had served as county superintendent of schools during my term as State superintendent of public instruction. I heard that he had given leases to a number of the prospectors then in the country, and soon received a letter from him inviting me to come down to Tonopah, offering me a lease as an inducement for the trip.

Arriving at Tonopah on the 14th day of January, I was the possessor of just four silver dollars. My first investment was in a poker game, which netted me a month's board and $12, with which I commenced operations on lease No. 19.

The camp at that time consisted of half a dozen or more tents and about thirty people, all highly enthusiastic over the new camp, and indulging in dreams of wealth which in a number of cases were realized. Everyone was flat "broke," including the owner of the property, but the little store, which had on sale a small and varied stock, was generous in extending credit to the men whose sole capital was a pair of willing hands and a lease on the big find. My lease, as I have stated, was No. 19, the first on the Mizpah Ledge, the other leases from 1 to 18 having been granted on the Valley View and Burro Ledges. Not a scratch of the pen secured any of these contracts. They were all oral, and the boundary of each man's working ground was marked simply by setting up a stone monument at each end of the ground allotted, which in most cases was one hundred feet on the strike of the ledge.

We experienced a hard struggle to get tools to work with, powder with which to break the ground, and food to support us while we were delving in Mother Earth's treasure box. It was just as remarked by a stranger who arrived in the camp after the lessees had been working about four months: "There is nothing in this camp but money"; and after we had been working about three or four months we had plenty of that, but it was extremely difficult to get supplies. We were more than sixty miles from the nearest railroad station, and the base of the supply was at Reno, 240 miles distant. The railroad facilities were very poor, as the Carson and Colorado Railroad, which runs from Moundhouse south, was narrow gage, very poorly equipped, and the sudden rush of business just about paralyzed the little road.

It required a long time to stock the road from Sodaville, the railroad terminus, to Tonopah with wagons and horses sufficient to supply the people who rushed in, and there was never a time when anyone in the camp could say that he had a "square" meal. For ten days at a stretch the camp lived on sardines, canned salmon, and crackers. This condition put the boarding-house keeper out of business, for these items of food were very expensive, but they were all that could be secured.

During this leasing period in the development of Tonopah the brotherhood of man was most strikingly manifested. Everything in the camp was common property, and no one quarreled with his neighbor. If my neighbor had powder, he divided it with me as long as it lasted. If I had an overcoat and he had none, he wore mine. You were liable to find some new arrival in your bed when you came off the hill after a day's work, but it was all taken good-naturedly.

A circumstance which is worthy of special mention, and is perhaps unprecedented in the annals of mining camps, was the fact that nothing but Jim Butler's word was given to secure to the lessees their rights on the property. There was not a quarrel nor a lawsuit in the camp, although a difference of six inches in a man's line might result in a difference to him of a sum written with five or six figures. I recall when I drew the papers by which the present owners of the mine took the property over from Butler, that an effort was made to have the discoverer cancel the leases he had given, but he refused, and consented to sell only with the expressed agreement that those working on the property should continue to operate under their leases until the first of the year, when they expired; and every promise given by Jim Butler was carefully carried out and secured. Had I the literary ability and you the space, I feel that a

sketch of Jim Butler would furnish a story which would interest and entertain your readers, as Butler is unmistakably one of the most picturesque characters the West has produced.

In reviewing the many events which have passed since the discovery of the now famous Mizpah Ledge, I almost hesitate in a task which is truly worthy of the pen of the romancer. For the history of Tonopah and its original discovery reads more like a fabled tale of old than a stern narration of a modern quest for gold.

Glancing backward over the five years which have passed since Jim Butler, a picturesque type of the Western prospector, through the sheer caprice of fortune stumbled on the golden ledge, I can scarcely realize that the few open cuts, which marked the first development work, should to-day be the open ways to a mine whose visible ore is far into the millions, and a camp whose fame will in time exceed that of Virginia City, Placerville, or Nevada City, of the generations that have passed.

I doubt very much if the outside world realizes that in these mines, developed in a brief period of five years, there is very nearly two hundred million dollars' worth of high-grade ore in sight. During the leasing period of the one mine, which continued for one year from January, 1901, the camp produced in the neighborhood of five million dollars in ore. Many men were made rich, and the foundation of my own fortune came with the operation of Lease No. 19, the first worked on the Mizpah Ledge.

Correspondence.

The Scientific American Wrappers.

To the Editor of the SCIENTIFIC AMERICAN:

I was pleased to note to-day that my paper came enclosed in a wrapper. As I have had more or less trouble in receiving the paper torn and slightly soiled on account of its not being in a wrapper, I can appreciate the change.

This paper I prize highly and strive to keep in a neat and clean condition, as at each year's end I have it nicely bound into a volume, therefore we subscribers who value our paper cannot help but appreciate the new idea. ERNEST C. CHESWELL.

Malden, Mass., September 1, 1905.

[We note with pleasure the comment of our subscriber, and we would be pleased to have other expressions of opinion. We have installed a Belknap Rapid Addressing machine which prints the address on and cuts the wrapper off from a continuous web of paper. This will add to the certainty of the subscriber's receiving his paper in good order. The speed of operation, 60,000 a day, will also insure its prompt delivery.—EDITOR.]

Is the Mosquito the Only Cause of Yellow Fever?

To the Editor of the SCIENTIFIC AMERICAN:

Just at this time, when the mosquito theory of yellow fever transmission is undergoing its first real test in our country, many persons are asking themselves the question, Does this theory account for all known cases of yellow fever? In many instances it apparently does not, e. g., where the disease has followed the reception of a lock of hair from a dead yellow-fever patient by persons at a distance from the place of the epidemic, or the handling of clothing, goods, etc., from infected districts. These instances are too well authenticated to be doubted; but, so far as the writer knows, they have not been explained under the mosquito theory, and for this reason the theory has not been wholly accepted by many.

In reading of the brilliant Cuban demonstration of the theory, it seems to me there is a gap in the series of experiments wherein may lie a suggestion, if not an explanation, of the cause of infection in cases like those alluded to. It is stated that the *Stegomyia fasciata* does not feed upon yellow-fever fomites and that the said fomites cannot directly transmit the disease. But I have nowhere read that uninfected mosquitoes and non-immune persons were shut up with yellow-fever fomites for two weeks, or any other length of time. No matter what may be the opinion in regard to the mosquito's feeding upon fomites, it seems reasonable from a scientific point of view that an experiment of this kind should have been made. Perhaps it was made, but, if so, it has not been mentioned, so far as my knowledge goes.

If a mosquito can be infected by fomites, cases such as have been mentioned might be explained under the mosquito theory. If the mosquito cannot be infected by fomites and fomites cannot directly transmit the disease, how are such cases to be accounted for under the theory? C. H. CARSON, JR.

Savannah, Ga., August 31, 1905.

Improvement of Fog Horns.

To the Editor of the SCIENTIFIC AMERICAN:

The numerous collisions which occur between vessels at sea during the prevalence of fog, and the narrow escapes which we occasionally hear of, but which are generally kept discreetly quiet by captains and vessel owners, would seem to show that the system of fog horns as at present in use is by no means perfect or satisfactory. One defect in them is that, although the sound of a fog horn may be heard by the crew of another ship, there is no means of telling in what direction the vessel on which it is sounded is going, or even where it is, because fog renders futile all reliable calculations as to distance and direction. And again, all or nearly all fog horns, I believe, whether on vessels or on dangerous points of land, are pitched on the same note, which is also conducive to errors, which in some cases end disastrously, as, for instance, when the captain of the steamer "Montreal," lying in the Straits of Belle Isle in a fog some years ago, mistook the fog horn of the steamer "Lake Erie" for that of the fog horn on Cape Ball, and steaming north to avoid the supposed danger of the Newfoundland coast crashed on to Belle Isle, when the boat became a total wreck—fortunately, without loss of life.

Now, why should not vessel fog horns be built with a musical scale of not less than five notes, and more, if necessary. Taking the scale of C major, the notes would be C, D, E, F, G. To avoid confusion with lighthouse and shore fog horns, a vessel should never use less than two notes, and the order in which these notes are sounded should serve to show in what direction the ship is moving. As an example of what could be arranged:

The notes C, D would mean "Going due north."
The notes D, C would mean "Going due south."
The notes C, E would mean "Going due east."
The notes E, C would mean "Going due west."
The notes C, D, E would mean "Going due northeast."
The notes C, E, G would mean "Going due northwest."
The notes E, D, C would mean "Going due southeast."
The notes G, E, C would mean "Going due southwest."

The intermediate points of the compass, such as NNE, SSW, etc., could all be indicated by adding another note or two to the scale. This is based on all vessels going north and east using the ascending scale, and those going south and west the descending scale.

There would be a little difficulty, of course, as regarding sailing vessels that had no steam for sounding their fog horns, and it would necessitate their carrying a supply of horns pitched on different keys to be used by the blower in their proper order.

Such, in brief, are the suggestions I would make, and should these ideas or similar ones be utilized with the result of making sea-travel safer and freer from the risks which now attend it, these few lines will not have been written in vain. G. DE W. GREEN.

Toronto, Canada, August 30, 1905.

Automobile Notes.

A number of serious accidents to autos racing on the track—accidents in which several well-known drivers have been maimed for life—have well nigh put a stop to track racing. The risks run are too great, and the gains to the makers of the cars practically *nil* save for the advertising value of a fast car. The speeds reached are too great for any short, curved course to be traversed in safety, even if it were dustless, which is generally anything but the case. Track racing is poor sport at the best, as close finishes are rare, and generally only about half the cars entered compete. If the energy which has been spent in the promotion of race meets is now diverted into the perfecting of the regular road machines, there is every reason to believe that the greatest good of the greatest number will be reached thereby.

Although a halt has been called to track racing, road racing both here and abroad continues to be more or less popular. The second contest for the Vanderbilt trophy will be run over a 28.3-mile course on Long Island, on October 14, the course being encircled ten times by each contestant, and there being no controls. Five Italian, French, German, and American cars will compete. The American cars will be selected in an eliminating trial on the 23d instant. The Richard-Brazier cars, which won the Bennett cup the last two years, will not compete, but a car of the same make that won the Vanderbilt trophy last year, viz., Panhard, as well as a Renault, De Dietrich, Darracq, and Hotchkiss, are entered.

A record 200-mile run was made recently from Paris to Havre in 4 hours by a 40-horse-power Mercedes car. Two well-known New York ladies missed the boat train, but, securing an automobile and two chauffeurs, they followed it over the roads. Although the roads were very slippery from rain, the car succeeded in making Havre in time to catch the steamer, it having made but one stop for fuel during the entire distance. If it is possible to do so well on roads, how much better time could be made on rails. It would seem as if the railway companies would have several automobiles adapted to run on their tracks, always ready for use in case of just such emergencies.

The high-speed motor car has at last had a road test in which it served a practical purpose, viz., the delivery of the Paris edition of the New York Herald at the seaside resorts of Trouville and Dieppe some five hours earlier than it was possible to deliver it by trains, owing to improper facilities. The newspaper was delivered an entire week at each resort, and the 129 miles between Paris and Trouville were covered one day in 2 hours and 10 minutes. The papers left Paris at 4 A. M., and by 6:30 they were on sale at the watering place. High-powered Mercedes and Bollée machines were used in the two services, and both ran perfectly and made very fast time. The latter especially made a splendid performance under adverse weather conditions.

An 820-mile French reliability test took place recently in the south of France and through the Pyrenees Mountains. Marks were awarded on average speed between controls, fuel consumption per ton-kilometer, speed on the level and on hills, brakes, ease of starting, elegance and comfort, the mechanism and the chauffeur's management of it, and the condition of the car at the finish. Some 50 cars, among which were some new French makes and a Spanish car, went through the test successfully, and showed themselves to be very reliable, despite the fact that heavy rains made the roads very slippery a considerable part of the journey. One car, which was driven too fast around a turn, smashed into a parapet and killed its owner.

A long-distance tour for a trophy offered, designed, and executed by Prof. Von Herkimer was recently run off in Germany. A total distance of 573½ miles was covered in 3 days, the longest stage being from Munich to Baden Baden—222¼ miles. The second day Nuremberg was reached, and the third brought the tourists back to their starting point. Although supposedly a tour, this event degenerated into a road race, the contestants being enveloped in clouds of dust and having scarcely any pleasure. Despite unnecessarily fast driving, 69 cars finished the tour out of 79 that started and 34 of these had no tire or mechanical troubles whatever. A 40-horse-power Mercedes won the trophy with only 25 marks against it, and a 40-horse-power and 60-horse-power Mercedes were respectively second and third. Five English Daimler cars competed and made a good showing, one of them being driven by a lady. Had tire trouble not counted, there would have been a good many more perfect scores.

The motor bicycle has been receiving a good deal of attention lately in America, France, and England. In SUPPLEMENT 1546 we described a motorcycle race that was held some months ago in France. Last month the Federation of American Motorcyclists conducted an endurance contest from New York to Waltham, Mass., in which, out of 44 starters, 34 finished, 28 of them with perfect scores. An average speed of 15 miles an hour was maintained, and not allowed to be exceeded by the winners. Among the successful contestants were 3 Curtis, 3 Wagner, 4 Thoroughbred, 3 Metz, 3 Yale-California, 11 Indian, and 1 each Tribune and Reliance machines. No less than 23 machines arrived exactly at 7:20 P. M.—the earliest minute at which they were allowed to finish. The roads were good most of the way, but between Springfield and Worcester they were very sandy, and caused all but the most expert riders considerable difficulty in traveling over them. A number of riders dropped out because of bad falls, and not from troubles with their machines. At the meet of the Federation, G. H. Curtis (whose two-cylinder machine we illustrated in our February 20, 1904, issue) won a 25-mile road race in 34 minutes, 21 1-5 seconds; and F. C. Hoyt, on a 1¾-horse-power Indian bicycle, covered 31 miles on the Waltham cement cycle track with a fuel consumption of 1 pint of gasoline. A six-day motorcycle reliability test over a 767-mile course was also held in England last month. Out of 32 machines that started, 22 finished, some 16 of them with perfect scores. The test included the climbing of several long grades and a "surprise" stop and start on a hill. Besides the motor bicycles, several light tri-cars went through the run successfully.

New Land in the Arctic Regions.

News received from Reikjavik from a member of the Duke of Orleans's Greenland party, says the expedition discovered a new and unknown land, which was named Terre de France, and also discovered that Cape Bismarck is part of a large island, and not on the mainland, as hitherto assumed.

After reaching 78 degrees 16 minutes north, the "Belgica," with the French expedition on board, headed in a southeasterly direction.

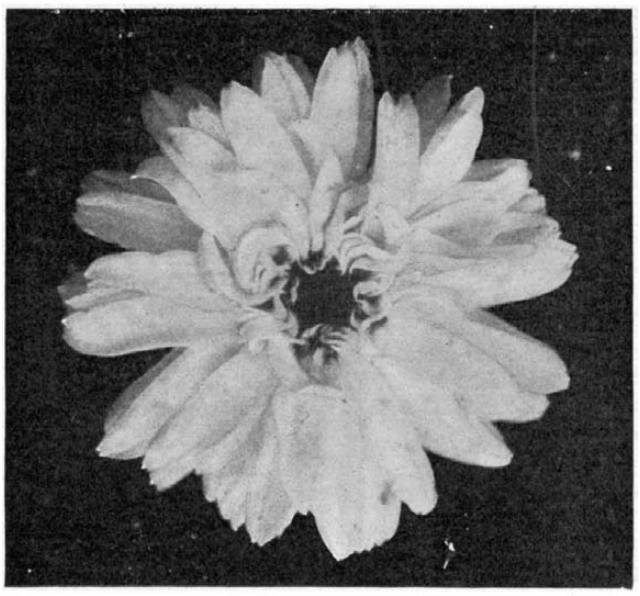
Discovery of a "Nova" at Harvard.

A new star, a " nova," was discovered at the Harvard Observatory August 31 by Mrs. W. P. Fleming in the constellation Aquila, which at 8 P. M. just now is about on the meridian and half way from the southern horizon to the zenith. A "nova" is not a common thing in astronomy, though among the most interesting and suggestive of phenomena. According to Prof. Pickering, only eleven of them have been discovered since 1848, and none at all had been noted in the 178 years preceding that date.

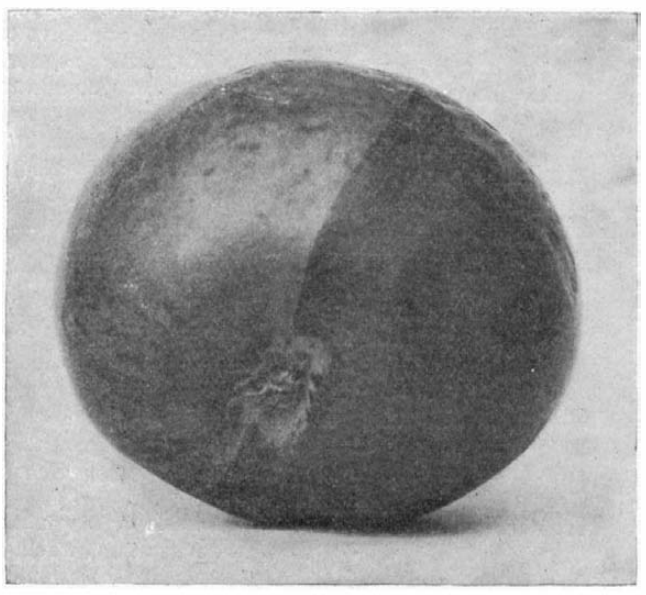
LUTHER BURBANK AND PLANT BREEDING.*

BY ENOS BROWN.

To Luther Burbank has been granted the knowledge, supreme beyond other men, of the susceptibility of plants to vary under the influence of new environments, delicate manipulation, and intelligent direction. Variations in plants, in color, size, fragrance, or form, have been observed by biologists from the first, but the phenomenon of change was regarded as a simple order of nature and an additional instance of nature's lavish endowments. That plants could be made to respond to a dominant will, and that the character, appearance, or habits of a plant might be controlled or altered, and that new ones might be created out of a combination of others, was never dreamed of or imagined, but all these strange things have been demonstrated as facts in the later years of the present generation.



Daisy Shasta, One-Third Natural Size.



Hybrid Baldwin Apple, One-Half Yellow, One-Half Red.

The theory of plant evolution has, in a brief period, been even more conclusively established than the most enthusiastic disciple of Darwin ever conceived to be possible. That the scene of these superlatively impressive manifestations of the power of the mind over the natural impulses of plant life should have been developed in the farthest West is something to astonish the most credulous.

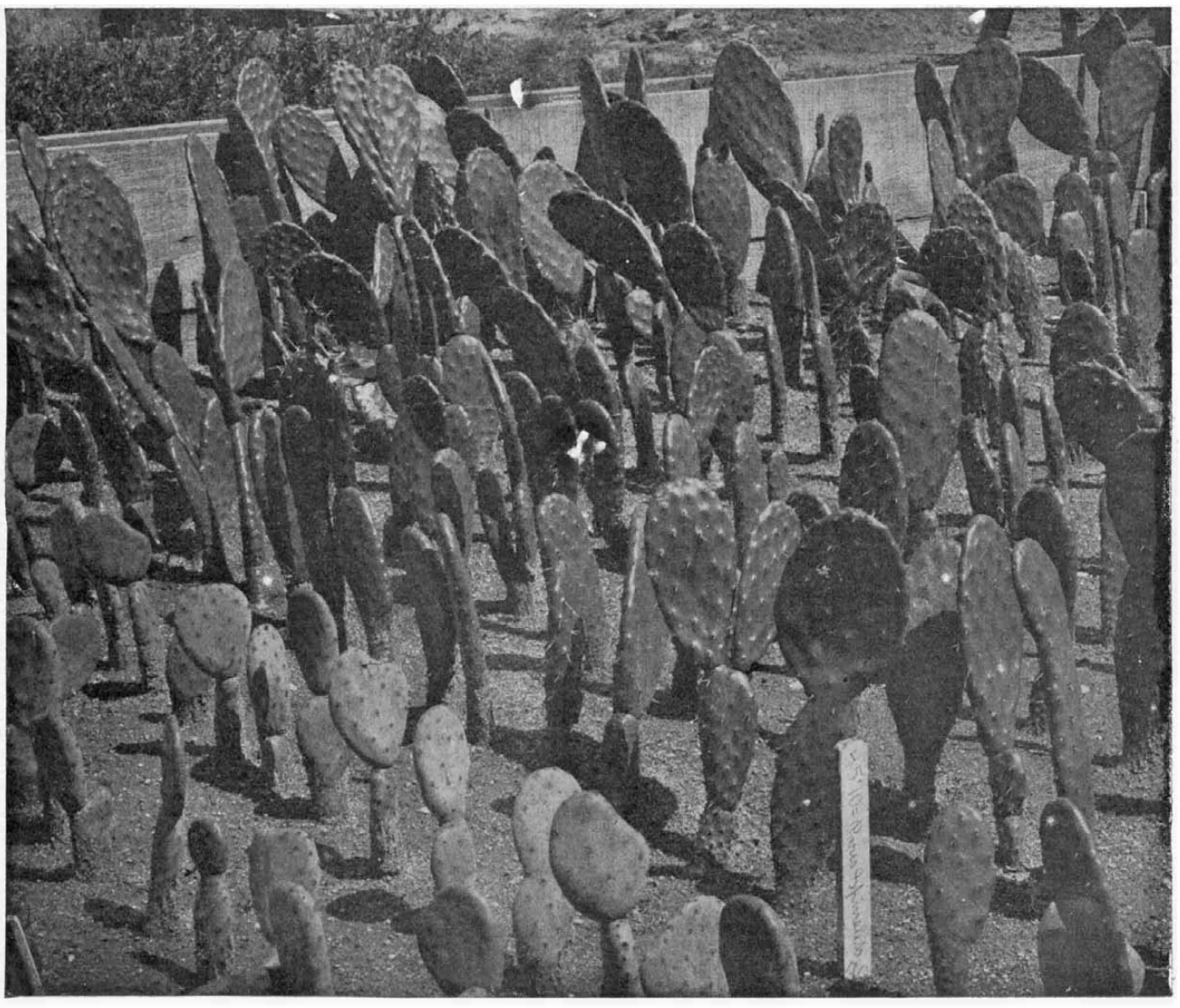
It is only ten years since Mr. Burbank began those experiments which have lately culminated. For thirty years a resident of Santa Rosa, Sonoma County, he was perfectly acquainted with all the conditions of climate and soil which distinguished this portion of California. In ages past a lake spread its broad area over this valley, depositing in time a rich alluvial soil of great depth. Frosts are of rare occurrence, and plant growth, no matter how delicate, is never arrested from this cause. In no region is there a combination of circumstances more favorable for fullest development or successful experimentation.

The marvelous results attained are due to nothing but rational methods, insight, close observation and a highly developed knowledge of plant instinct, altogether directed by scientific attainments of the highest order and with a definite object always in view.

It has been established that wild flowers are stubborn in maintaining their original form. In a bed of one thousand, or even ten thousand blossoms, for that matter, there may be but one exhibiting variation. The change may be upward or downward, an improvement or otherwise. It makes no difference to the plant breeder. One plant susceptible to change has been found, and is selected for further experiment. All the remaining plants, the unchangeables, are uprooted and destroyed. Upon the one the which he is seeking. Minute attention to details is one secret of the success attained. Sterilization extends not only to the soil in which seeds are planted, but to the fertilizer with which the soil is enriched. Hostile germs are destroyed by boiling the soil. The boxes are sterilized by a solution of sulphate of copper. Mr. Burbank has correspondents in every part of the world where the science of botany is understood or a botanist penetrates. Scientific associations everywhere are his coadjutors. Persons in every zone forward to him new types. For him to look at a seed is to identify it. The environments and conditions of growth are understood as soon as the home latitude of the plant is ascertained. Identical environments of a plant may be imitated, and later, by graft or hybridizing, new vigor, which means greater power of resistance to lower temperatures, may be imparted. A conspicuous instance of this fact is the yellow calla, which is naturally confined to a limited area in the sub-tropical regions of South Africa. At home it is an extremely fragile plant. By hybridizing and crossing with the ordinary white calla of the United States a deep yellow flower has been evolved as hardy as the native variety. The first crossing resulted in light and dark yellow flowers. Subsequent crossings yielded flowers as deep in color as the original. It has taken years to develop these qualities in its new environments, but there is no reason why the yellow should not be cultivated in temperatures where the common white now flourishes. To the residents of New and Old Mexico, Arizona, Texas, and Central America the qualities, amiable and otherwise, which pre-eminently distinguish the prickly pear need not be enlarged upon. In the hothouses of the North small specimens of the plant are cherished as conclusive exhibitions of the eccentricities of nature. In its home this cactus grows to the dimensions of trees and is used as fences to protect the domicile against the intrusion of any animal, wild or domestic. Its sharp thorns are impregnable to assault. Divested of its spines the prickly pear as a food plant has a value equaling one-half that of alfalfa. It propagates itself with little moisture. Cattle eat it with avidity, but the spines, introduced into the intestines, cause death. A more conclusive test of the practical value of the theories of Mr. Burbank, then, in an endeavor to divest the prickly pear of its thorns, could not be imagined. This he undertook to do, and succeeded.

In certain parts of Central America there grows a species of prickly pear which has no spines or spikes, the only thorns with which the plant is endowed being the spicules found within the leaves. A plant of this variety was set out in the experimental grounds and crossed or hybridized with five Northern species, producing a type in which the spines were almost eliminated. Continued crossings produced in the fifth or sixth generation a plant completely thornless. Succeeding efforts resulted in a cactus in which every evidence of even a spicule had vanished. The new plant is hardy and of vigorous growth. One plant in the grounds is three years old and stands eight feet high, covering a space perhaps five feet square. Upon it there are one hundred and seventy leaves, and the whole plant weighs nine hundred pounds. The fruit is of delicious flavor, somewhat like the pineapple, only more delicate. The deserts of the South may be clothed in the spineless cactus at no late day. Its value would be incalculable.

The magnificent crimson poppy, which bears a flower fully eighteen inches in circumference, is a product of hybridizing the opium with the Oriental. The first generation produced a flower having a narrow crimson streak. In this all the pistils excepting those which were crimson were cut off or amputated. These seeds were, in due



Bed of Cactus Seedlings, Thornless, Showing a Few Reversions.

LUTHER BURBANK AND PLANT BREEDING.

*From American Homes and Gardens, August, 1905.

time, planted, and a flower nearly solid crimson bloomed from the stem. Successive efforts eliminated every other color but the one desired. It is the glory of the field; a whole garden in itself. It took three or four years and many generations to create, but the great crimson poppy is now a permanent addition to the ornaments of the garden. As showing the results of continued crossings, in a bed containing hundreds of thousands of leaves there could be seen no two which were alike.

The California poppy, Eschscholtzia, naturally rich, deep yellow in color, by following up a rare specimen in which only a vein of crimson appeared, has developed a new type which is all crimson.

The fragrant verbena is a product of selection and crossing. A plant was discovered in which a trait of ancestry revived and exhibited itself in one specimen, which was discovered by the plant breeder and its fragrance restored.

The amarylis has been bred into a new plant, colossal in size and gorgeous in color. Its size has been increased to four times greater than the original, and measures from eight to ten inches across.

A wild white blackberry crossed with the Lawton produces a much clearer white, and is infinitely more productive than the Lawton and of finer flavor.

The common daisy of the North has, by hybridizing and selection, developed into a flower four and five times as large as the original and many times more beautiful. The variations of the new plant are endless.

The latest wonder to be established at the experimental farm are two new types of the black walnut tree, and named the Paradox and Royal. The first is a crossing of the common English walnut with the California, the latter between the Eastern and the California. In front of the Burbank home there are trees of the Paradox, not yet fourteen years of age, which measure two feet and over in diameter at a height of three feet above the ground. It is claimed that these trees are by twenty-five to fifty per cent. more rapid growers than any others known. The quality of the wood for finishing is said to be very superior, and it takes on a beautiful finish.

No one expects a plant to flourish without proper nourishment. The plant responds quickly to genial culture. In color combination a new type is found or else the greater peculiarities of one of the parents. Color is certain waves of light. Soils known as alkali produce colors in which the red is predominant. In soils with acid combination blue is most conspicuous.

Permanence of the new types is assured. A gain in color, form, vigor, size, fragrance or quality, in the direction of variation, once secured, is as liable to endure as new varieties of fruits, berries, and flowers which have been established for generations.

To enumerate all the variations upon established types built up under Mr. Burbank's methods would be impossible. There is no end of them. Upon no species of plant life, be it flower, berry, or fruit, has crossing and hybridizing failed to produce the most wonderful changes. When a change is noted the avenue is opened for variations in every direction. Time is the greatest element in all plant modifications. It may take years to develop to the full realization of the hopes of the plant breeder. Any property, color, shape, size, or fragrance may remain dormant, to be brought out under the influence of improved cultivation or the stimulation of some influence imparted by the hybridizing process. The best or the worst qualities of a plant may be confined in a single one. The expert plant breeder will combine many traits in order to produce the type he is searching for.

The element of precision enters into all of Mr. Burbank's operations. The depth to which seeds should be planted, nature of soil required, the proper temperature, exposure, shady or otherwise, moist or dry—all of these particulars are observed and recorded with infinite care. When the plants appear a careful selection is made of the most promising. These selected plants are never lost sight of. Then preferences (for their mute language is understood) are humored. If color is the object sought, every other tendency is lost sight of but that; so for size, form, or fragrance. Later a combination of all these qualities may be merged into the one. Cultivation will not produce new type, but crossing and hybridizing almost always will.

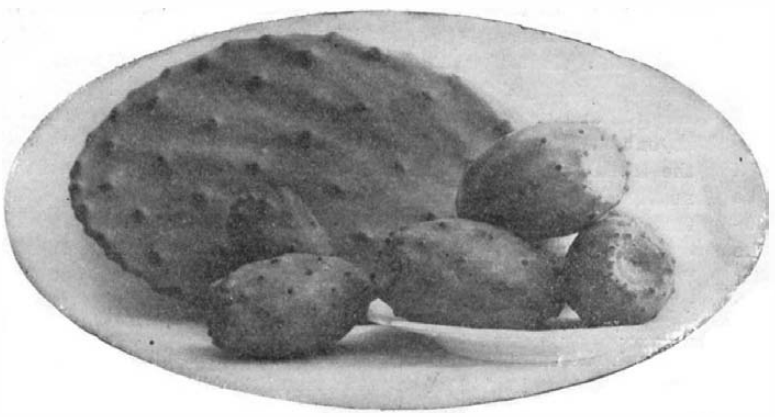
Pollination is effective only at the moment selected by the plant itself. To some plants the time is when the bees appear. The evening primrose selects the time when the night moths are abroad. Pollen is sometimes applied with the finger; a camel's-hair brush is used in the case of certain plants. Pollen is gathered early in the morning. Sometimes buds are picked and the pollen taken as they ripen and open. The plants thus treated are tagged and watched and their character and habits recorded. It may be years before the results of all this care and detail are known to a certainty.

Mr. Burbank expresses himself as follows regarding the vast possibilities of plant breeding. They can hardly be estimated.

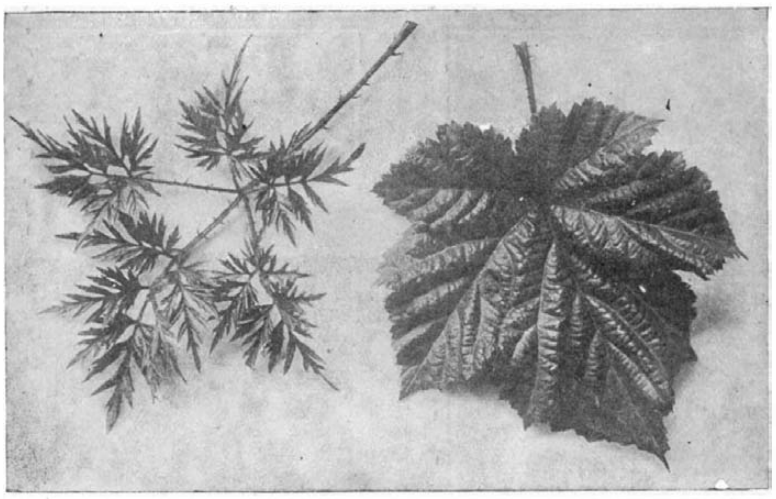
"It would not be difficult for one man to breed a new rye, wheat, barley, oats, or rice which would produce one grain more to each head, or a corn to produce an extra kernel to each ear, another potato to each plant, or an apple, plum, orange, or nut to each tree.

"What would be the result? Nature would produce annually without extra cost or effort, 5,200,000 extra bushels of corn, 15,000,000 extra bushels of wheat, 20,000,000 extra bushels of oats, 1,500,000 bushels more of barley, and 21,000,000 extra bushels of potatoes. Not for one year only, but as a permanent legacy for all future generations."

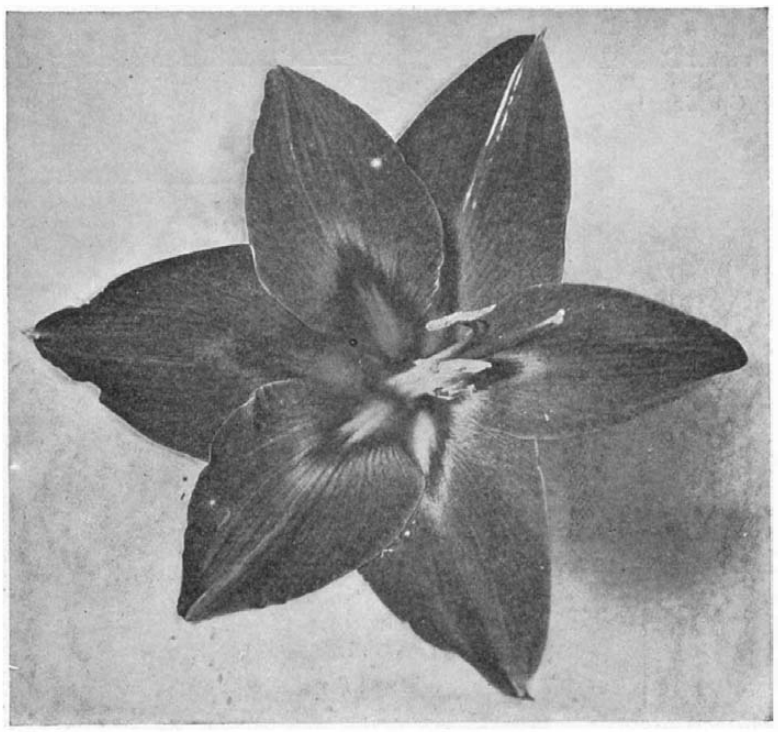
Truly a wonderful outlook!



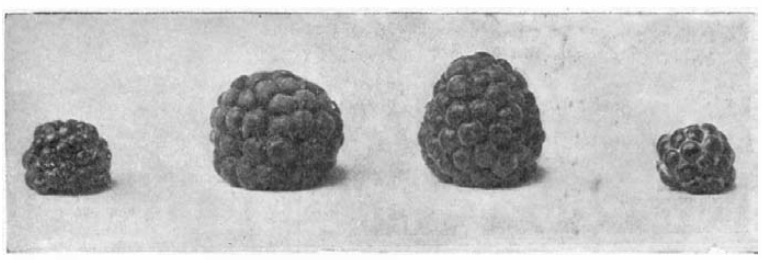
A Thornless Cactus Not Yet Deprived of Its Spicules.



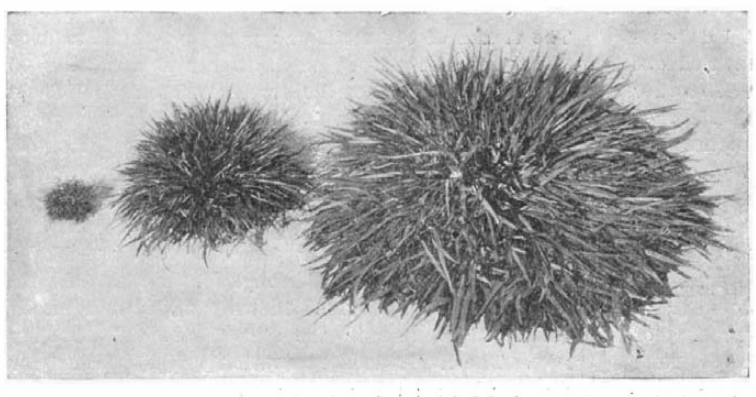
Extreme Form of Blackberry Leaves Produced by Hybridization of Two Distinct Species.



An Amarylis One-Quarter Natural Size.



The Two Central Raspberries were Produced from the Two Varieties at the Ends by Crossing and Selection.



Sweet Vernal Grass, Showing Great Variation in Size of Plants Grown from the Seed of One Plant.

Cactus Ready for the Hybridizer.

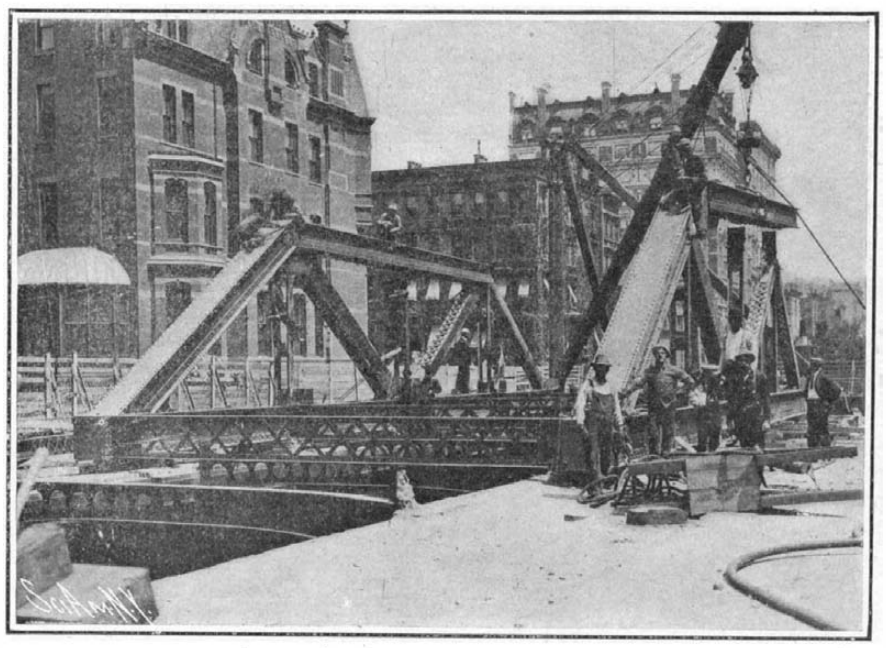
LUTHER BURBANK AND PLANT BREEDING.

THE GRAND CENTRAL STATION TERMINAL IMPROVEMENTS.

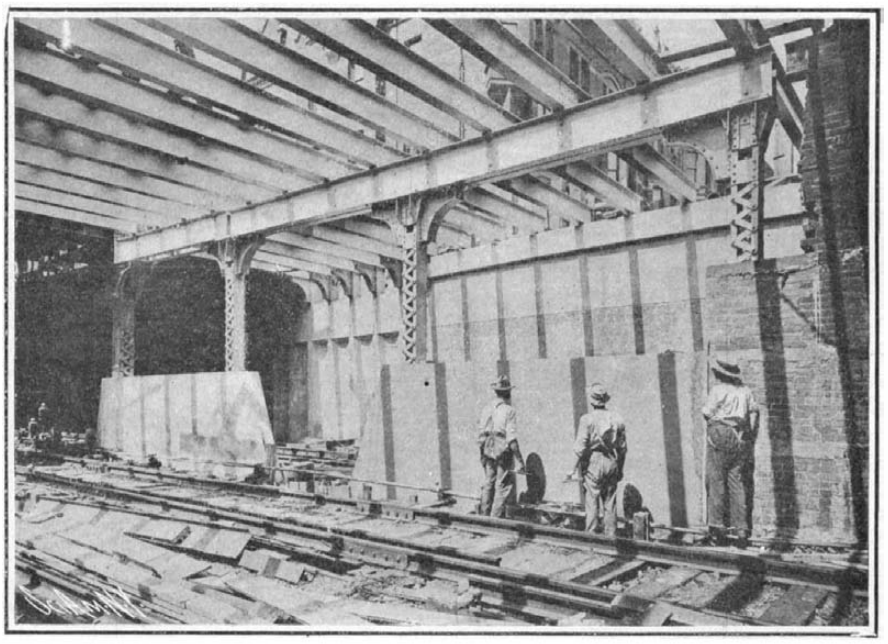
One of the features that render the construction of the new Grand Central terminal station a work of unprecedented and monumental proportions, is the vast amount of preliminary excavation that has to be carried out before a single track of the station yard, or a single brick or stone of the station building can be laid. This excavation amounts to a total of over 2,000,000 cubic yards, a large part of which is rock. The blasting out and digging of this material in the heart of a great city, and its removal and disposal many miles from the point of excavation, is in itself a task of huge proportions.

The vast amount of excavation that is being done at the site of the new station is necessitated by the fact that the tracks, both of the terminal yard and in the two miles in length, below Park Avenue. This tunnel will not be enlarged by the addition of more tracks, but its capacity for the regular passage of trains will be enormously enlarged for the reason that the storage yard for cars and engines will no longer be at Mott Haven, beyond the Harlem River, but will be located within the terminal yard itself. This means that the large number of empty trains that used to be taken out through the tunnel to Mott Haven for cleaning and overhauling, will remain in the terminal yard between trips, and the present congestion through the tunnel will be relieved to that extent, enabling a much larger number of regular daily passenger trains to be run through the tunnel in the twenty-four hours. Furthermore, the installation of electric traction will render the tunnel atmosphere clear, and will enable the trains to run under closer headway.

to Fiftieth Street, where they will open out into the main yard, and occupy the space from Lexington Avenue to a line 100 feet east from Madison Avenue to Forty-third Street, and thence to Forty-second Street the station ground will be bounded by Vanderbilt Avenue on the west and for a shorter distance by Depew Place on the east. After the station yard has been completed, all the cross streets from Fifty-seventh Street to the north face of the terminal station will be restored, and a driveway will be formed on each side of Park Avenue. From these streets and driveways it will be possible to look down upon the upper deck of the terminal yard. Ultimately, however, it is likely that the blocks bounded by these streets will be covered by buildings, thus entirely shutting in the station yard. Provisions for the footings of these buildings will be made during the construction of the terminal.

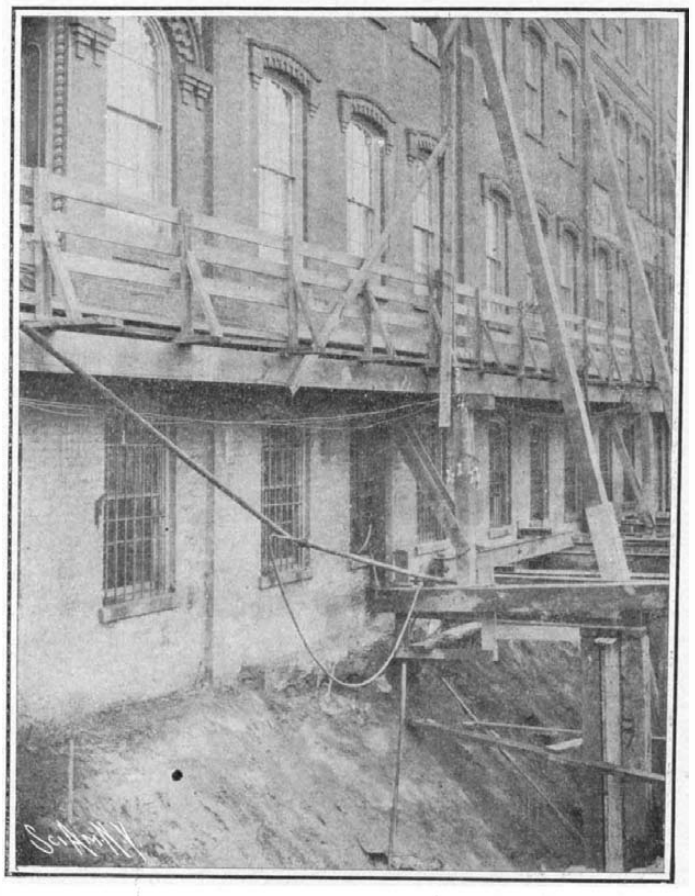


Erecting a Truss Above the Present Wells Opening Into the Park Avenue Tunnel.

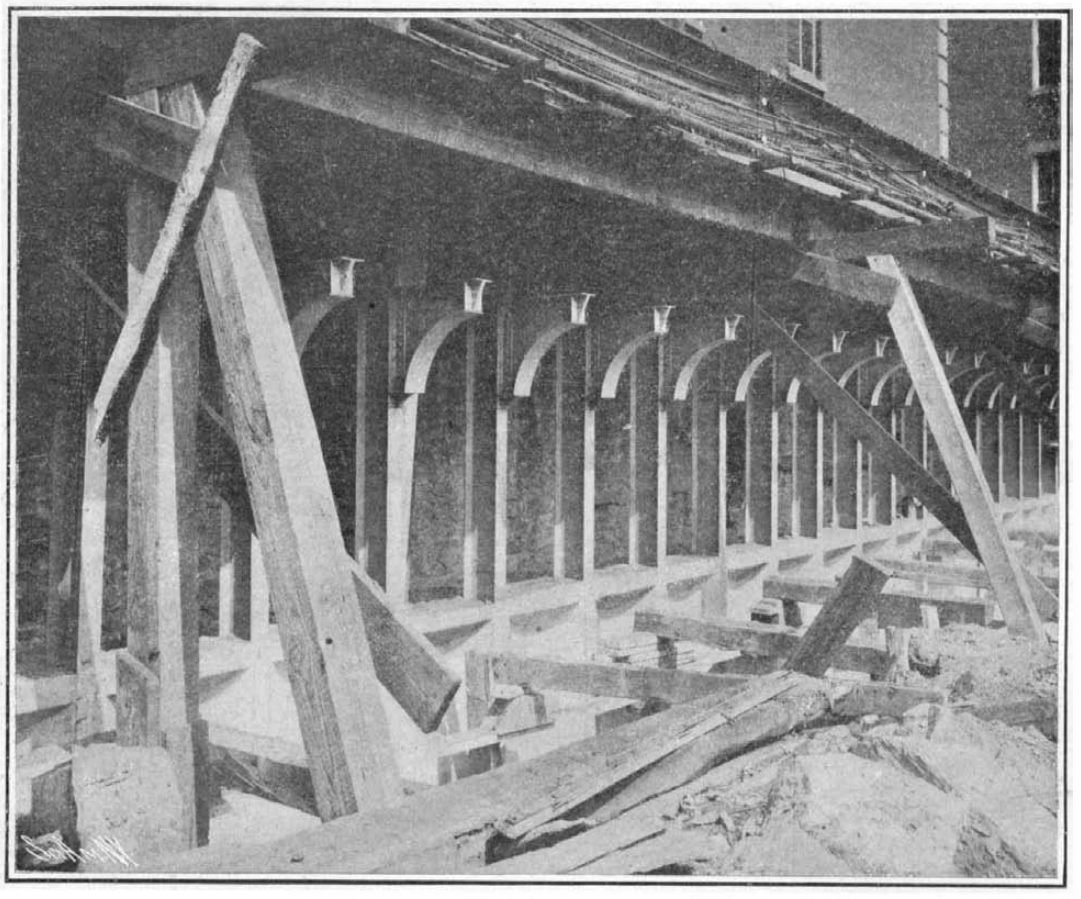


Note the concrete walls to protect the bases of the columns in case of a derailment.

Where the Tunnel Opens Into the Yard.



Costly Underpinning to Carry the Steinway Factory Walls During Excavation.



Construction of I-Beam and Concrete Side Wall of the Station Yard.

THE GRAND CENTRAL STATION IMPROVEMENTS, NEW YORK.

station itself, will be carried on two levels, one above the other, and to the further fact that the whole of the double-decked terminal, as thus constructed, will be below street grade. The total average depth of the excavation to sub-grade of the suburban tracks on the lower deck will be about 35 feet. The area to be excavated will extend the total width of Park Avenue for a distance of 1,700 feet from Fiftieth to Forty-fifth Street, and it will extend from Vanderbilt Avenue to Lexington Avenue from Forty-fifth to Forty-second Street. The difficulty of the work will be more fully understood when it is mentioned that every cubic yard of the total of over 2,000,000 yards has to be taken out and removed through the four-track tunnel, which is the only means of access to the station, without interfering with the regular traffic of the road.

The entrance to the present and to the future terminal station is by way of the existing four-track tunnel,

The new station yards will commence at Fifty-seventh Street, where the tunnel has been excavated out to the full width of Park Avenue—140 feet. In order to enable the turnouts to be made without interference from supporting columns, a massive steel truss has been erected at this point for carrying the roof of the tunnel. Provision against accident at these turnouts is further secured by imbedding the lower half of the columns in continuous concrete walls. It is expected that if a derailment should at any time occur, these walls will serve as a shield to protect the columns, and also to prevent the telescoping or serious wrecking of the cars. This is a safety provision which we commend to the consideration of the builders of our future subways in this city, in which, at all curves, there should be similar continuous concrete walls between adjoining tracks. The 140-foot excavation will provide width for ten parallel tracks, which will be continued down

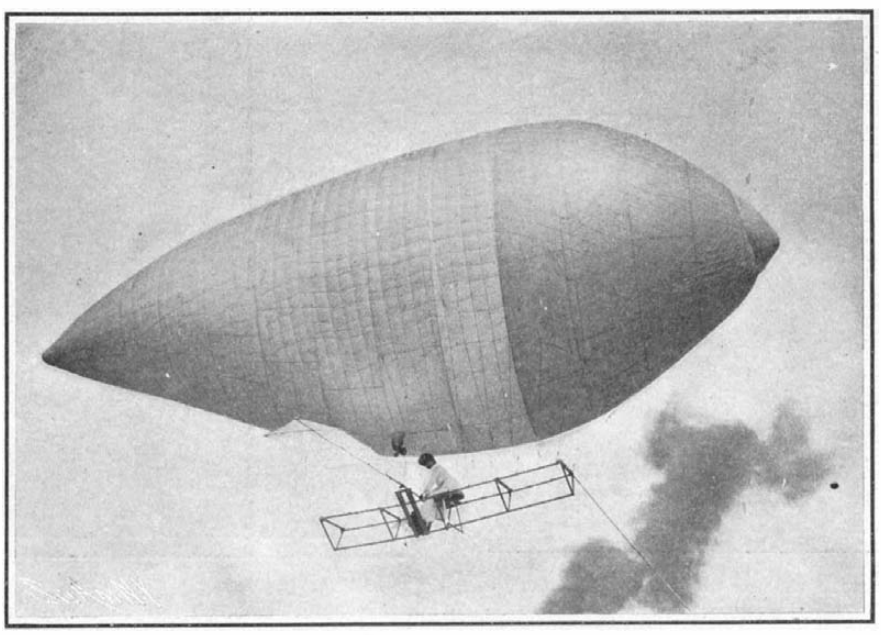
The tracks of the main or upper yard begin to drop at Fifty-seventh Street, until they reach a level 15 feet below the grade of the present tracks. This level is continuous over the whole of the yard and through the terminal building. At Fifty-third Street the two outermost of the ten tracks begin to drop on a two per cent grade to the level of the lower deck, which will be 35 feet below street grade. The excavation for the lower level for suburban trains will not extend over the full width of the yard throughout its entire length. This level will be provided in the station with fifteen parallel tracks, and in the station yard with thirty tracks. The lower deck excavation will be carried for its full width as far north as Forty-eighth Street, whence it will narrow gradually to the point where it meets the two outermost suburban inclines, that lead up to the common level in the tunnel.

The method of carrying through the work so as not

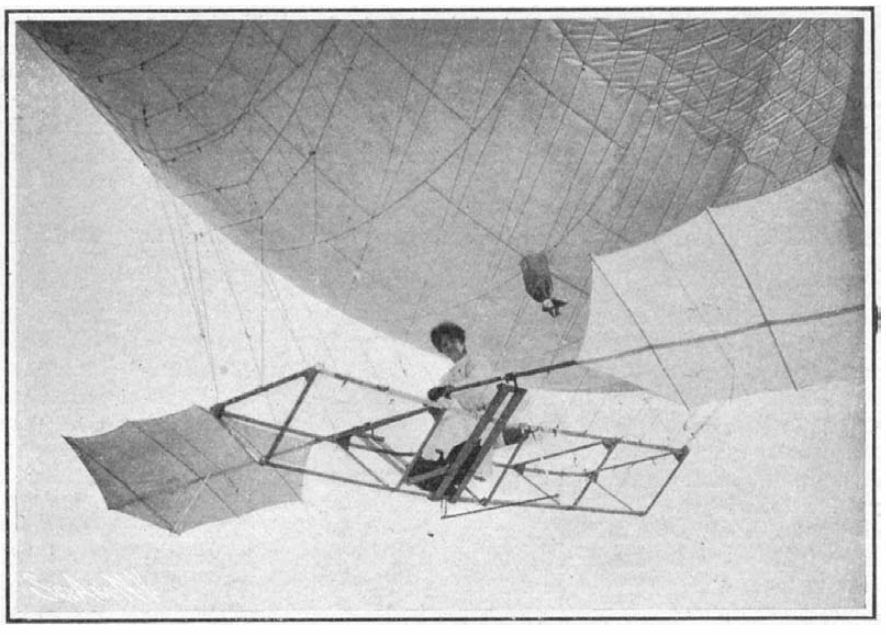
to interfere with existing traffic will be to excavate for two or three tracks at the main yard or upper level, each side of the approach to the main yard, and put in a temporary station for the use of the suburban traffic on the easterly side of the yard. When this has been done a straight section will be excavated right down through the yard, and then the western section will be taken out. The lower level construction will be carried on conjointly with that of the main yard, or at least as far as it is possible to do so. The excavation is being done chiefly by steam shovel. The material is loaded directly on to flat cars, and is taken out through the tunnel, and used chiefly in widening the embankment of the New York Central roadbed sufficiently to provide for a fourth track from New York to Croton, a distance of 34 miles. There is also sufficient material for adding, if desired, a fifth or sixth track roadbed, while a large amount of the material has been used for filling in fifty or sixty acres of land belonging to the company at Highbridge marshes, ground which will be very serviceable for storage purposes.

The excavation of the station has called for some very careful work in underpinning the buildings that front on Park Avenue. One of our photographs shows an extensive piece of needle-beam work put in to carry the weight of the Steinway piano factory, and is a fair sample of the difficulties encountered. The side walls of the excavation are formed of 15-inch vertical I-beams, placed 3 feet 6 inches between centers, with concrete arches turned in between. The roof, forming the roadways of Park Avenue and the intersecting streets, is formed of 24-inch I-beams, with flooring of reinforced concrete or of buckleplate.

The terminal station was described and illustrated in our issue of January 21 of this year, to which article reference is now made for further particulars; but it may be mentioned here that the southerly façade extends for 300 feet on Forty-second Street, and the westerly façade for 680 feet on Vanderbilt Avenue. The building will also have a frontage on Forty-fifth Street of 625 feet, and on Lexington Avenue of 400 feet. The station will include a ticket lobby, 90 feet by 300 feet, and a grand concourse 160 feet by 470 feet in length, with a height from floor to top of dome roof of 150 feet. Our acknowledgments are due to Mr. W. J. Wilgus, the vice-president, and to Mr. A. B. Corthell, the terminal engineer of the New York Central Company, for assistance in the preparation of the present article.



Rowing in the Skies



The Car and the Wing-like Oars With Which the Aerial Rowboat is Propelled.

AN AERIAL ROWBOAT.

BY E. O. SAWYER.

A late feature of the attempts to navigate the air is an aerial rowboat which has been constructed by Alva L. Reynolds, of Los Angeles, Cal. It is composed of a gas bag whose equator is much nearer the front of the bag than usual, and a light framework which supports the occupant. It is raised and lowered, propelled forward and backward by the use of a pair of wing-like oars.

By the use of weights the bag can be made to raise just a half pound less than the weight of the occupant. Then gravity is overcome by the use of the oars. Any one who understands how to row can operate the aerial rowboat. So far no experienced aeronaut has ridden in the machine, although several hundred people have tried their hand at rowing up and down the park where the machine is being tested.

The bag is 37 feet long and 15 feet in diameter at the equator. To raise the car and an occupant weighing 150 pounds, 2,500 cubic feet of gas is sufficient.

One of the features of the new air-boat is that the cost of building a car and bag sufficient to carry one person is but a trifle over one hundred dollars. A speed of from four to six miles an hour has been attained by good oarsmen. There is always the drawback, characteristic also of the ordinary rowboat, that it is difficult to row against the current, or rather against the wind in this case.

Wines of the port type are made by taking colored grapes and crushing and putting them in fermenting vats to ferment the same as for making red wines. As soon as fermentation has reduced the sugar in the must to the desired point (during which fermentation color and other matters have also been extracted from the pulp and skins), the juice is drawn off, put in storage cooperage, and fortified.

Increasing the Life of Telephone Poles.

During the past year the Forest Service, in co-operation with the American Telephone and Telegraph Company and the Postal Telegraph-Cable Company, has been making an investigation to find the best methods of seasoning telephone poles and of treating them with preservatives.

Fifty green poles were furnished every month to each of five experimental stations. Each pole was exposed to the open air, and was weighed every month until it ceased to lose weight. The rate at which weight was lost showed the rate of seasoning in different months.

After one year of seasoning, preservative treatment was applied to the poles, beginning last spring. Several different preservatives and three different methods of applying the preservatives were experimented with. Most of the poles at two of the stations—Wilmington and Pisgah, N. C.—were treated by applying the preservatives with a brush. In a few cases a cap or plate was fitted to the butt of the pole and creosote forced in with a pump, but with unsatisfactory results. Both chestnut and juniper poles were treated by these methods. To test the efficacy of the treatment as a preventive against decay, these poles, carefully numbered and labeled for identification, have been set in an experimental section of the American Telephone and Telegraph Company, between Savannah and Meldrim, Ga. Each treated pole is set between a green and a seasoned pole, so that the absolute and relative values of the different preservatives will be fully tested.

The third method of applying the preservative is that from which the best results are expected. This method was applied to chestnut poles only. At Dover, N. J., in addition to the external applications, a number of seasoned poles were treated in an open tank, constructed to permit the treatment of 30-foot poles inclined at an angle of 20 degrees. In this tank the poles are boiled in creosote for several hours. They are then either shifted to a tank of similar construction containing cold creosote, in which they stand for several hours, or are left in the hot oil to cool down gradually. This treatment covers the pole with creosote to a distance of from 8 to 10 feet from the butt. Up to this time a penetration of one inch and an absorption per pole of 35 to 40 pounds of creosote have been obtained. Changes in the method of operation are almost daily increasing the depth of penetration and amount of absorption. This is the first apparatus of this character constructed in the United States for impregnating the butts of telephone and telegraph poles, and the success which is being attained with it indicates the practicability of its widespread adoption in commercial practice.

Since the life of such poles is determined by the decay at the ground line, only the section from the bottom of the pole to about two feet above the ground line needs to be treated. Creosote is expensive, and if the whole pole must be treated the added years of service may not compensate for the outlay—it may be cheaper to use two untreated rather than one treated pole. But if an effective method of treating not more than 8 or 10 feet of a pole can be found, there is every reason to expect that treatment will prove profitable to the users of poles as well as an economy of forest material.

The Delay of Old Age.

In the August issue of the Buffalo Medical Journal, Dr. Charles G. Stockton deliberates on a topic that is of interest to all mankind, namely, the consideration of what may be done to postpone age and to render it more tolerable when it no longer is avoidable. One of the aspects of the subject that deserves especial consideration, says the author, is the improvement in the nutrition of the aged as the result of good teeth. In his opinion it is doubtful if we fully appreciate how much the dentists have contributed to good health and longevity. Thereupon he pays his compliments to the oculists and observes: "Who can estimate the additional resources both of usefulness and happiness secured through the discovery of spectacles and the operation for cataract? Useful eyesight contributes much toward good health and long life, for the reason that it permits of a continued interest in living which otherwise would be lost. . . . Perhaps no one factor is so important in maintaining courage and health in old people as the creation and continuance of some keen interest in life." With reference to the time-worn but neglected subject of arterial disease, Dr. Stockton states that much may be done in the earlier steps of arteriosclerosis (a hardening of the arteries) if intelligent study be given to the individual, to his habits of life, to his excesses, and to his deficiencies. Emphasizing the importance of judging and correcting the disturbed balance between assimilation and waste, the doctor observes that there are successful methods of lessening the extent of auto-intoxication and of widening the field for the play of nutritional processes. He points to the fact that middle age often brings luxury and at the same period the contracting arteries narrow the field of physiologic activities.

In considering the question of what may be done to make old age more tolerable, the author gives it as his opinion that most of the derangements from which the aged suffer can be classified as belonging distinctly to pathology. He fears there exists a tendency among physicians to dismiss these matters as necessary corollaries of senility without giving them that careful consideration which similar processes receive in younger patients. Those who make a specialty of senile diseases seem to agree that complaints of the aged arise for the most part from toxic causes, and there is good reason for believing that this toxic state which underlies the decadence of senility takes its origin for the most part in the colon. This organ harbors an immense number of bacteria leading to fermentations, putrefactions, and the production of alkaloids, fatty acids, and toxins which man has to combat for the length of his mortal days.

In concluding his very interesting paper, the author says: "The indications are obvious. In addition to the usual measures for improving the general circulation, old people are benefited by systematic colonic lavage, stimulating baths with superficial massage, prescribed pulmonary gymnastics, and an abundant drinking of pure water."

Superheating is being forced to 554 deg. F. on the Prussian State railroads. When steam is superheated to 500 deg. F., a saving of 16 per cent in steam and 12 per cent in fuel can be obtained, as compared with similar locomotives using saturated steam, the greater saving in water than in fuel being due mostly to the prevention of losses caused by condensation.

A RESPIRATORY APPARATUS FOR FIREMEN.

BY ARTHUR INKERSLEY.

An ingenious respiratory apparatus for the use of firemen has been invented by Mr. Charles E. Chapin, a mechanical draftsman who lives in Berkeley, Cal. It consists of a hood lined with oiled silk to cover the head and an air cylinder which is strapped on the back. The cylinder is divided into three chambers, carrying under a pressure that can be regulated enough air to last an hour. The air is conducted by a rubber tube to the headpiece, the exhaled air passing out through a valve before the mouth. The fireman can get enough air to fill his lungs comfortably but cannot expend the supply in a short time, as he might be tempted to do if he became frightened. The main supply of air comes from the outer cylinders, the middle one being smaller and to be drawn upon only after the other two are exhausted. The apparatus can be adjusted on the back in half a minute, and, as it weighs only 23 pounds, it does not impede the fireman in his work.

A test of the apparatus has been made in the presence of the fire chief of San Francisco. A man equipped with the apparatus entered a room filled with the fumes of burning sulphur and worked there for a full hour, coming out with his throat and lungs perfectly free. The fire commissioners of San Francisco will have a practical demonstration of the apparatus, which is simple and not likely to get out of order. If on further test it proves satisfactory, it will be adopted by the San Francisco fire department and, doubtless, by the fire commissioners of other cities and towns.

A Hood Lined with Oiled Silk Covers the Head of the Fireman.

An Air Cylinder is Strapped on the Back of the Fireman. Enough Air is Carried to Last an Hour.

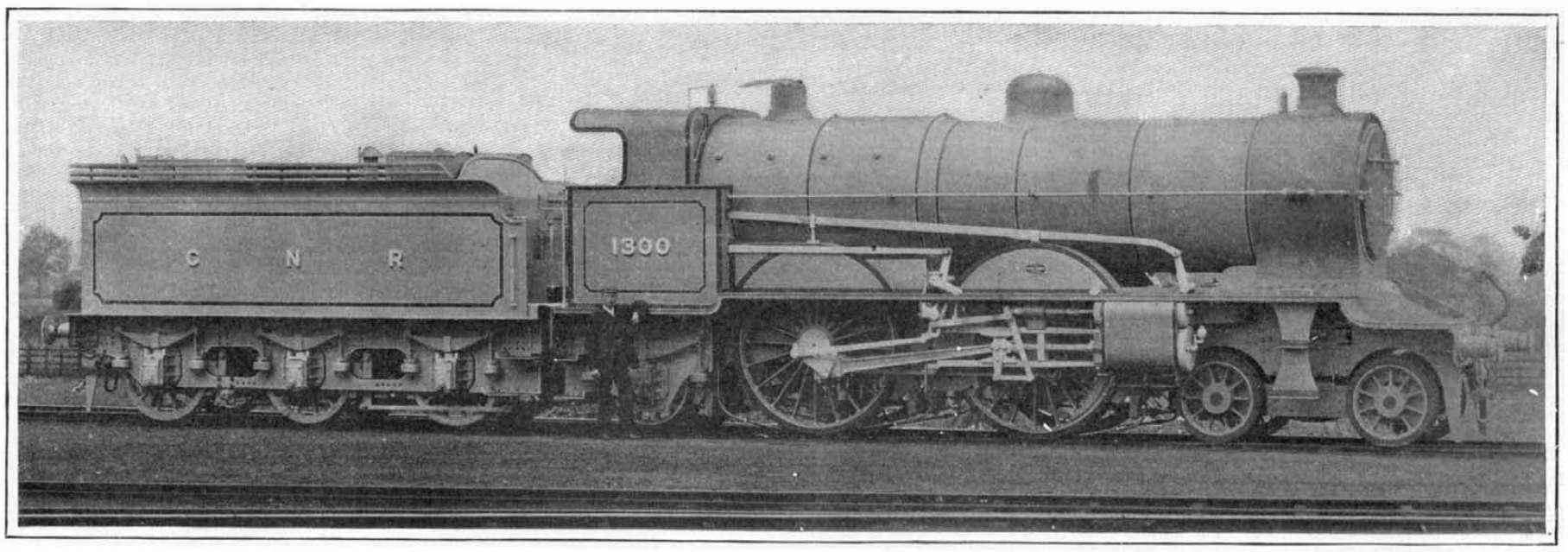
A RESPIRATORY APPARATUS FOR FIREMEN.

THE MOST POWERFUL EXPRESS LOCOMOTIVE IN GREAT BRITAIN.

Although not one of the largest, in point of track mileage, the Great Northern Railway is one of the most important of British railways, as it forms an important connecting link in the East Coast route between London and Scotland. Among the British railways, the Great Northern was foremost in the adoption, for its fastest passenger traffic, of the well-known "Atlantic" type of locomotive, a considerable number of which have, during the past three or four years, been introduced into service. Although these "Atlantic" *simple* locomotives are generally regarded as being well abreast of the times, and represent some 35 per cent more power than the engines they replaced, yet the directorate of the company, acting upon a suggestion made by their locomotive engineer, some short time ago took the unusual step of issuing invitations to locomotive builders, specifying the duty to be done, and asking them to build engines, compound or otherwise, for trial on the Great Northern. In accordance with this decision, a contract was, toward the end of last year, placed with a private firm for a powerful, experimental, four-cylinder, balanced compound locomotive of the "Atlantic" type, to be built from designs submitted by the builders. The placing of this order by the Great Northern Railway Company is rendered all the more interesting by reason of the fact that all the leading British railways have for many years past made it a practice to build and repair all of their locomotives at their own works—the private locomotive establishments of Great Britain being left to deal only with the work required by the smaller railways of Great Britain, and also locomotive contracts for the British colonies and for foreign delivery.

The new four-cylinder balanced "compound" of the Great Northern Railway Company has quite recently been completed, and, by the courtesy of the builders, the Vulcan Foundry, Limited, we are enabled to reproduce the photograph and give the following particulars illustrating this unique type of British express engine. As will be noticed from the engraving, the engine is of rather unusual proportions for a British railway, and happens to be not only the heaviest, but also the largest locomotive of its type ever built in Great Britain for operation over a British railway. The high-pressure cylinders are 14 inches in diameter, the low-pressure cylinders are 23 inches in diameter, and the piston stroke in each case is 26 inches. The driving wheels are 6 feet 8 inches in diameter on tread, the diameter of center being 6 feet 2 inches. The boiler barrel has a length of 11 feet 11 inches, with an outside diameter of 5 feet 1⅝ inches, the thickness of the plates being 11/16 of an inch. The total heating surface is 2,514 square feet, to which the tubes (which number 149 and are 2¾ inches in diameter outside, with a length of 12 feet 4 inches and of Serve steel) contribute 2,344 square feet, and the firebox the remaining 170 square feet. The working pressure is 200 pounds per square inch, and the grate area 31 square feet. The copper firebox has a length of 9 feet, a width of 4 feet 10¼ inches, and a depth at the front of 6 feet 4½ inches and a depth at the back of 4 feet 9 inches. It was restricted in size on account of the smoke troughs in the running sheds, and also the coaling platforms on the Great Northern Railway, and it was for these reasons that the "Belpaire" pattern firebox, which had been originally designed for this locomotive, could not be used. The engine, it is of interest to note, has been fitted with a starting valve, which is so designed as to admit steam, at a reduced pressure, to the receiver at starting. The screw reversing gear is designed so as to permit the cut-off in one cylinder, or set of cylinders, to be varried independently of that in the other. This insures that the expansion shall be reasonably shared between the cylinders, and prevents undue rise of pressure in the receiver, with the resulting excessive stresses on the low-pressure piston. The motion may be reversed from any position in one gear to the corresponding one in the other by moving one handle, and there is no possibility of jamming the screw, as in some of the other arrangements now in use. The engine, exclusive of its tender, weighs 80 tons. The tender, which is of the Great Northern Company's own standard pattern, is carried on six wheels, each 4 feet 2 inches in diameter, has a capacity of 3,670 gallons of water and space for 5 tons of fuel, and weighs 45 tons, so that the new four-cylinder compound has an aggregate weight on metals of 125 tons. The engine is now being submitted to a series of exhaustive trials on the Great Northern Railway Company's main line.

Compound for Anatomical Preparations.—Mix first, hot, 16 parts of wheat flour beaten with as much cold water, and add 32 parts of boiling water, with 2 parts of pulverized gum arabic dissolved in 4 parts of boiling water, and boil the mixture over a gentle fire. On the other hand, dissolve 2 parts of pulverized alum in 4 parts of boiling water, and pour, stirring, into the first mixture, which is to be kept on the fire. After perfect homogeneity has been secured, add 2 parts of acetate of lead dissolved in 4 parts of boiling water. Finally, stir energetically and add about 1.50 parts of corrosive sublimate. This compound is antiseptic, but it must not be forgotten that it is poisonous.—Cosmos.



Cylinders: Diameter, 14 and 23 inches by 26 inches stroke. **Driving wheels,** 80 inches diameter. **Heating surface,** 2,514 square feet. **Steam pressure,** 200 pounds. **Weight of engine,** 80 tons; **tender,** 45 tons.

THE MOST POWERFUL EXPRESS LOCOMOTIVE IN GREAT BRITAIN.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

COMMON-BATTERY LOCK-OUT TELEPHONE.—M. P. BOONE, Peru, Ind. This invention consists in the novel construction and arrangement of the electromechanical parts and their coöperating circuits, in which when the line is clear and no party is talking a lock-out electromagnet at a subscriber's station connected between the earth and a wire leading through an impedance-coil to one side of the battery will be inoperative; but if a circuit be established between the two lines (through a telephone bridged on the line, for instance) then all the subscribers' lock-out electromagnets connected as described become operative to lock-out.

ELECTRICAL BINDING-SCREW OR TERMINAL.—M. BOUCHET, 22 Rue Alphonse de Neuville, Paris, France. The invention relates to an electrical binding-screw or terminal designed to facilitate the insertion of the conductor, and to completely protect its stripped end, to insure a perfect electrical contact, and to resist any stress to which the conductor may be accidentally subjected, the device if made principally of insulating material being capable of insuring a connection completely insulated from its surroundings whatever may be the diameter of the conductor clamped therein.

Of Interest to Farmers.

PLOW.—J. BEARD, Westport, Cal. In the present patent the invention refers to plows, and more particularly to the shape given to the same in order to enable it to cut a comparatively wide furrow with small draft upon the horse and without liability to foul when used in sticky soil. Upon actual trial Mr. Beard has found that the plow cuts as claimed above and without additional fatigue upon the part of the horse or other animal drafting the plow.

Of General Interest.

METALLIC WINDOW.—S. U. BARR, New York, N. Y. In the present patent the object of the inventor is the provision of a new and improved metallic window which is simple and compact in construction, completely air-tight and dust-proof, and arranged to permit convenient opening and closing of the sash.

SHOE-LACE FASTENER.—C. DÉLANO, Valparaiso, Chile. In the present patent the invention relates to boots and shoes and its object is the provision of a new and improved shoe-lace fastener arranged to securely hold the ends of the shoe-lace or tie-string in position without requiring the tying of knots.

FENCE.—J. C. CHIBER, Texas, Wis. The fence comprises the combination, with a base-piece having a series of holes in its side, and a post pivoted thereto, of fence-panels extending in opposite directions from the post and lapped upon the same, an eyebolt passing through the panels and the post and serving to secure them together, and a brace pivotally connected with the eyebolt and having its free end bent laterally at a right angle, whereby it is adapted to engage the holes in the base-piece.

COPY-HOLDER.—IONE HARTLEY, Nashville, Tenn. The invention in the present patent relates to devices for holding copy, and has for its principal objects the provision of a holder which will efficiently support copy in various forms and which may be readily adjusted to permit this or to meet the particular requirements of the user.

HOSE-SUPPORTER.—E. S. DORMAN, Plainfield, N. J. The aim of the inventor is to provide a supporter made entirely out of metal and in two pieces only, the construction being such that it is light, durable, and economic and will automatically fit to any leg without alteration or adjustment, and also to provide a device which will be cool when worn, and which will in no manner interfere with the circulation of the blood.

ORE-ROASTING KILN.—J. MCNAB, Catonsville, Md. In the present instance the invention is an improvement in ore-roasting kilns, and particularly in kilns designed for use in extracting sulfur from pyrites in the manufacture of sulfuric acid. The slabs forming the arches of the fire-places may be made of fire-clay, soapstone, or similar material.

HARMONICA OR MOUTH-ORGAN.—H. H. NEILSON, Perth, Ontario, Canada. The invention refers more especially to harmonicas or mouth-organs of that type in which a longitudinally-slidable mouthpiece is employed upon the instrument for the purpose of facilitating the playing as well as preventing soreness of the lips of the player by abrasive contact of the lips with portions of the instrument in the act of playing thereon. This class has many disadvantages and objections, such as, too much friction between instrument and mouthpiece, unpleasant tingling of the lips in playing, impairment of musical tones, etc., which Mr. Neilson's invention overcomes.

Hardware.

NUT-HOLDING WRENCH.—A. SCHURR, JR., Lloyd, Mont. An object of this inventor's improvement is to provide novel means for unscrewing the nut from an axle-spindle, so that the vehicle-wheel thereon may be removed for a lubrication of the axle-spindle, and also for a replacement of the wheel and nut on the spindle without directly handling the nut, thus avoiding soiling of the hands with the lubricant usually smeared over the nut.

Household Utilities.

BEDSTEAD.—C. H. GASAU, New York, N. Y. This invention has reference to improvements in bedsteads, an object being to provide a bedstead of novel construction that may be readily adjusted as to length, that may be quickly changed to form a crib, and that may be compactly folded for storage or transportation.

Machines and Mechanical Devices.

APPARATUS FOR CUTTING PLASTIC MATERIAL.—W. NIEBUR, JR., New York, N. Y. This device cuts plastic material into blocks or cakes. It is especially intended for cutting small cakes of butter from a large mass, and by means of the improvement cakes of any size may be rapidly cut without handling the cakes in any way. This is a decided advantage over the devices heretofore commonly employed for the purpose, since when the small cakes are formed handling of the cakes may tend seriously to misshape the cakes of butter. The present is a continuation of this inventor's copending application formerly filed.

TRANSOM-LIFTER.—J. W. NEFF, Morgantown, W. Va. The object had in view by Mr. Neff is the provision of means and devices adapted for working or lifting transoms which may not only be cheaply manufactured, but simple in construction and effective for easy working of pivoted or swinging transoms and windows in general having similar modes of attachment to their support.

Prime Movers and Their Accessories.

WAVE-MOTOR.—F. S. KEYES, Warren, Mass. In this patent the invention relates to apparatus for utilizing the energy of such movements in large bodies of water as waves. Its principal objects are the provision of an apparatus of this character in which the intermittent movement will be transferred into a continuous force by integrating the energy of successive waves and different parts of the same wave.

STARTING-CRANK FOR EXPLOSIVE-ENGINES.—W. H. SCHOONMAKER, Montclair, N. J. This crank is adapted especially for use in connection with internal-combustion engines in manually starting or "turning over" the same. Heretofore a common disadvantage and danger have existed in the backward turns of the engines, due to premature explosions during the starting operation, thus causing the crank or starting device to be violently torn from the hands of the operator and frequently injuring him. The invention overcomes this by providing a crank which as the engine "kicks back" automatically releases its connection with the engine, so that the engine-shaft may perform one or more revolutions without carrying the crank with it.

STEAM-BOILER.—G. O. STURTEVANT, Athol, Mass. Mr. Sturtevant's invention is an improvement in steam-boilers, and with his construction of boiler and support he is able to secure a maximum of heat, since all the radiation from the furnace-wall is utilized in heating the water. The radiation from the boiler is also utilized to a considerable extent.

Railways and Their Accessories.

RAILROAD-TRACK.—E. F. SEIDER, Upper Sandusky, Ohio. The inventor's object is to provide together with other improvements, novel devices for securing the rail-fastening spikes in connection with a metal rail-supporting plate. He is able to fasten a rail to a metal tie or sleeper, the latter to be a substitute for the wooden tie now generally employed. The tie prevents rails from spreading and rails may be laid more readily and uniformly, and require no gage in order to get proper width of track and keep it in line. Ballast can be packed around the tie so it will not creep or slide. Tie is made of any length, and where switches are run in the ties can be made any lengths and fasteners applied to any part of top plate to secure the rails.

SPEED AND DISTANCE INDICATOR.—E. SCHULTZ, Berlin, Germany. This invention consists in alternately and at equal intervals of time coupling and uncoupling a pointer to and from a rotating shaft, speed of the shaft being proportional to speed of traveling to be measured and the said pointer being adjusted to return automatically to its zero position under spring-pressure or by gravity or the like. More than one pointer can be used, in which case they are preferably so operated that one is coupled to the shaft at the moment at which another pointer is uncoupled from the latter. It may be used on railway-vehicles or other vehicles, also as a tachometer, or in cases where converting a rotary movement into rectilinear or circular movements rising from and falling to zero again.

Pertaining to Recreation.

TOY.—O. HAMMARLUND, New York, N. Y. The inventor provides a number of blocks having magnets therein. The blocks are preferably placed in a box, closable at will. In conjunction with the box he employs a device, a "detector-tube," which comprises a tubular body with a freely-mounted magnetic needle therein. By placing the blocks in the box and holding the detector over the same the needle will be actuated by the variously-positioned magnets in the box, and if the positions of the needles which correspond to the particular blocks has been memorized he can tell the locations of blocks within without removing the cover of the box.

Pertaining to Vehicles.

DUMPING-WAGON.—C. CARROLL, Chicago, Ill. In this case the invention is an improvement in dumping-wagons, and has for an object, among others, to provide a novel construction for supporting the screws and the traveling nuts for operating the lifting-rods connected with the body. The construction avoids exerting the weight of the load upon the screws in such manner as to bend the same downwardly, and will be found very effectual.

WHEEL.—P. J. CAESAR and E. SCHELL, St. Paul, Minn. The object in this instance is to construct a resilient wheel which will wholly or partly avoid the necessity of springs on the vehicle with which the wheel is used. This end is attained by a certain peculiar connection between the spokes and rim of the wheel, which involves a spring or cushion and which results in a resilient action between the spokes and rim.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Inquiry No. 7243.—For manufacturers of springs.

For mining engines. J. S. Mundy, Newark, N. J.

Inquiry No. 7244.—Wanted, the names of a few exporters of rosin.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 7245.—For makers of key ring tags and dies for marking the same.

Drying Machinery and Presses. Biles, Louisville, Ky.

Inquiry No. 7246.—For manufacturers of patented, mailable household articles.

2d-hand machinery. Walsh's Sons & Co., Newark, N.J.

Inquiry No. 7247.—For manufacturers of liquid carbonic acid.

Perforated Metals, Harrington & King Perforating Co., Chicago.

Inquiry No. 7248.—Wanted, the addresses of manufacturers of window sash locks.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 7249.—Wanted, a compressed air fire alarm whistle.

Adding, multiplying and dividing machine, all in one. Felt & Tarrant Mfg. Co., Chicago.

Inquiry No. 7250.—Wanted, a portable acetylene gas mine lamp.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 7251.—Wanted, the names of Brown machinery makers.

I sell patents. To buy, or having one to sell, write Chas. A. Scott, 719 Mutual Life Building, Buffalo, N. Y.

Inquiry No. 7252.—For manufacturers of paper bag machinery.

WANTED.—Patented specialties of merit, to manufacture and market. Power Specialty Co., Detroit, Mich.

Inquiry No. 7253.—For manufacturers of furniture, also of goods which can be sold by mail.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company, Foot of East 138th Street, New York.

Inquiry No. 7254.—For machinery used in making artificial granite or marble, as, for instance, cement blocks with a facing or veneering, or crushed marble which can be polished, same as solid marble.

Gut strings for Lawn Tennis, Musical Instruments, and other purposes made by P. F. Turner, 46th Street and Packers Avenue, Chicago, Ill.

Inquiry No. 7255.—For a device to measure and fill cans.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, wood fiber machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 7256.—Wanted, the name and address of the makers of the steel termed "Invar."

Absolute privacy for inventors and experimenting. A well-equipped private laboratory can be rented on moderate terms from the Electrical Testing Laboratories, 548 East 80th St., New York. Write to-day.

Inquiry No. 7257.—For makers of a collapsible box or barrel to be used for crockery in large packages.

WANTED.—The patents or sole agency for Britain and France, of new machines and articles used in the Brewing and Allied Trades. Highest references given and required. State best terms with full particulars to "Wideawake," care of Street's Agency, 30 Cornhill, London, England.

Inquiry No. 7258.—For manufacturers of heavy felt, such as felt shoe soles are made of.

Inquiry No. 7259.—For manufacturers of large springs, such as are used for large music boxes, clocks, etc.

Inquiry No. 7260.—Wanted, prices of machinery, and also estimate on complete outfit for the manufacture of soap, to produce from 3,000 to 15,000 pounds a day of 10 hours.

Inquiry No. 7261.—For dealers in the Febeardsley Axle Cutter, or the Beardsley Axle and Thread Cutter.

Inquiry No. 7262.—For a machine for making round toothpicks.

Inquiry No. 7263.—For manufacturers of leatherboard or other leather composition, likely to use powdered leather or leather turnings.

Inquiry No. 7264.—For manufacturers of bonbons and fondants.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9763) W. A. W. asks: Will you please inform me what number of watts will be consumed per hour by one T. H. constant-current series open arc on 50 volts and 9.6 amperes? A. A lamp consuming 9.6 amperes at 50 volts will in one hour consume 480 watt-hours (9.6×50). A watt-hour is one watt exerted for one hour. Your lamp uses 480 watts all the time it is lighted. Meters generally register watt-hours; 480 watts for one hour are 480 watt-hours. The question as you put it cannot be answered. Watts alone do not imply *time*. The time must be specified. Your lamp consumes 480 watts for any time it is lighted. In one hour it therefore consumes 480 watt-hours of electrical power. See Swoope's "Practical Electricity," page 218, price $2.

(9764) A. A. B. asks: I wish to ask through your paper if it is not possible for the manufacturers of incandescent light bulbs to complete the bulb without having to form the little sharp point on the rounded end? A. Incandescent lamp bulbs are made without any point upon the large end. They may be had from dealers in electric supplies.

(9765) C. L. H. asks: Can you tell me if any one makes an electric arc that could be used as a blowpipe? Something after the diagram sent. I wish to use it to melt small amounts of platinum. A. It is not difficult to arrange an electric arc blowpipe for melting metals, or soldering, in the manner your sketch shows. We should use the current which passes through the carbons for the magnet. Put the magnet of a few turns of wire in series with the carbons. Adjust the number of turns of wire and the distance of the magnet from the arc to produce the blowing power required. The apparatus is so simple that no special instruction is required for setting it up or operating it.

(9766) J. W. M. says: Would be glad to have you publish a decision of the following dispute: One party claims that a piece of iron, stone, or a piece of wood water-soaked until heavy enough to sink below the surface, would sink to the bottom of the ocean, no matter what the depth is at the point the object is placed in the water. The other party claims that they would remain suspended in the water at varying depths from the surface depending on their specific gravity, the iron even not reaching the bottom in the deeper parts of the ocean. A. A body which will sink at all in water will sink to the bottom. Sea water is compressed but 44 millionths by one atmosphere, and at higher pressures it is compressed less. Metals are more compressible than water. Hence it is seen that a piece of metal will have its density increased more as it sinks than the sea water will, and it will sink faster as it sinks deeper.

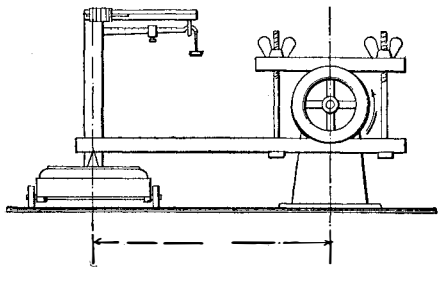
(9767) C. H. B. asks: Will you please tell me whether or not the angle formed by the sun's rays with the earth's surface at forty-five degrees of latitude, when the sun is directly above the equator, is forty-five degrees? I ask this question to settle a difference of opinion. A. In latitude 45 deg., when the sun is vertically over the equator its rays make an angle of 45 deg. at noon with a horizontal plane; but not at any other hour of the day.

(9768) J. E. B. asks: Please answer the following questions. They are of great importance to your reader. 1. Is force an inherent property of matter? 2. Is life a force, differing from gravitation or chemical affinity only in degree? Or is it an entity, separate and independent of matter? 3. Are life, soul, and form identical? If not, what is the difference? 4. Is the brain the reasoning organ, or the organ of that which reasons? 5. Is it the quantity or the quality of brain, or both quality and quantity of brain combined, that are responsible for the degree of reasoning power possessed by the individual? 6. Can animals be hypnotized? If not, why not? A. The questions which you submit are truly of great importance, but they can hardly be classed as scientific questions in a physical sense. They are rather metaphysical or philosophical, and one's answers would be very powerfully influenced by his general views upon philosophy. We should hesitate to project a discussion of these matters into our columns, since when one has given his answer, his an-

swer is simply his opinions, and another has as good a right to differ as to agree. We think it is generally held that force is not inherent in matter, since the same amount of matter can have different quantities of force at different times. For example, water in the forms of ice and steam possesses very different amounts of force from what it has as water. At absolute zero matter has no heat energy. It is probable that some hold the material view of life, that it is similar to ordinary forces, but that is not our personal view. We think too that the brain is the organ of a being who reasons, acts, and controls his own actions, for which he is held responsible both in law and morals. This view seems to us to be fundamental to the existence of the state and nation as well as to morality. So too we should say that quality of brain is more controlling than quantity, although very small brains are usually indicative of low intelligence. No balance can determine the qualities of a brain completely, any more than a scalpel can separate, or dissect life from the living being, and say, "I have found it." We believe that animals can be hypnotized.

(9769) J. W., writes: I always like to read the SCIENTIFIC AMERICAN, but I must take exception to the article, "The Pigmies of the Congo," of August 5. I cannot see how *you* can use such apodeictic statements regarding the long-exploded *theories* of evolution. I think that is not worthy of the SCIENTIFIC AMERICAN. Again, we have had now *ad nauseam* about reasoning cats. Animals (brutes) cannot reason, simply because they have no *rational soul*. The brain can *think* no more of itself than an ax can chop of itself—both are but instruments in the hands of an individual that *knows how*. A. We note with regret your criticisms of certain expressions in a recent article regarding pigmies, and also of the letters from correspondents showing remarkable instances of intelligence in animals. The printing of a letter from a correspondent does not in any way commit the paper to an indorsement of the views contained in the letter. The correspondence column is the property of the correspondents, and very frequently matter appears there to which the editor would personally most emphatically dissent. It seems to be the inalienable right of Americans to an expression of their opinions in print, and we are quite willing to grant some space to such free expression. We feel sure that good comes of it. However, with reference to the remarkable instances cited, we simply ask why deny to a quadruped a mode of action which is granted to a human being under similar circumstances. If a young child jumps up and opens a door in the manner the cat did, without any instruction, we should call it remarkable and an act of reason. The difference is not far to seek. The cat goes no further; the child does. Animal reason is narrow in range, and cannot be indefinitely developed. Nor can the child's, for that matter. But the human limitations are far beyond those of the animal. We believe that our view is shared by many scholars. As to the hypothesis of evolution, while we do not elect ourselves defenders of it or of any other special mode of the production of the present state of life on the earth, we must say that our acquaintance with the colleges and the professors of biology in them leads us to think that evolution is now more firmly believed by those whose studies give them the right to an opinion about it than it ever has been. We do not know a professor of biology who is not an evolutionist. Doubtless the pendulum of thought in this direction is not yet at rest, and will swing to and fro so long as mind remains active, but it seems certain that the old beliefs have no longer the hold upon scholars that they had previous to the publication of the "Origin of Species" by Mr. Darwin. We are not biologists, but as careful observers of the trend of science we think we rightly represent the state of present opinion.

(9770) J. B. A. says: In "Notes and Queries" No. 9544 asks for rule for calculating power of gas engines, and the answer gives the rule which answers a question that I would have asked sooner or later, but I wish to go a little farther and ask: How do you proceed in making the "actual brake test" for horse-power in gas engines? I bought an engine rated at 2½ horse-power, and they wrote me, after shipping, that the engine developed nearly 4 horse-power actual brake test. A. In order to make a brake test of an engine, it is necessary to construct on the flywheel of the engine a Prony brake, which acts on the principle of the one shown in the drawing. Two



pieces of wood are clamped about the pulley in such a way that the friction can be increased or decreased, as desired, by tightening the bolts. If the pulley is large, very often a number of ropes are used in place of the lower clamp in such a way that they may be tightened by means of screwing up a bolt from the pulley. One of the arms is extended a considerable distance, so as to allow its farther end to rest on a knife edge on the platform of a scale, or else be attached to a spring balance. In order to make tests, the screws of the brake are tightened until the engine is carrying the full load that it is able to carry without having its speed reduced too much. The pressure which the arm exerts on the platform scale is weighed, and the number of revolutions which the engine makes per minute is counted. During the test it is often necessary to have some means of applying water to the pulley to prevent its becoming too hot. The horse-power is figured by the following formula: Horse-power = 6.28 times the weight on the scale in pounds times the length of the arm measured from the center of the pulley to the knife edge in feet, times the number of revolutions per minute, divided by 33,000.

(9771) F. W. C. asks for a liquid polish for metals. A. Try the following:

Peroxide of iron (jewelers' rouge)	20 parts
Rotten stone	20 parts
Infusorial earth	20 parts
Oxalic acid	1 part
Palm oil sufficient.	
Vaseline sufficient.	
Oil of mirbane sufficient to perfume.	

Pulverize and mix, so proportioning the palm oil and vaseline that you have a liquid sufficiently "thick" to hold the powders in suspension. We would remind you that the preparation of polishes, simple as it seems, is an art, and, like every other, requires a certain amount of practical experience, as well as a knowledge of the materials entering into the composition of the polishing mixture used, and of their preparation for use. To attain a high and uniform grade of polish, the materials must be reduced to a very fine and uniform powder. One single grain of the material larger or sharper than the rest will produce scratches that interfere with the finish given the metal. To make sure of your jewelers' rouge being free from dust and grit, prepare it fresh, as follows: Make a solution of iron sulphate (copperas), and another of oxalic acid. Add the latter to the former, as long as it throws down a precipitate. Filter off the liquid, and wash the residue on the filter with repeated charges of water, and dry. When dry, place in a suitable container, and heat gently. It soon ignites and burns until only an impalpable powder is left. This is the polishing material. The infusorial earth must be freed from sand, grit, etc., and reduced by grinding to a condition similar to that of the iron peroxide. The rotten stone and acid must also be powdered. If care and attention be given to these details, you can scarcely fail to get good results.

(9772) L. L. L. asks: Why do all dummy advertising clocks in front of jewelry stores read 8 o'clock and 17 minutes? A. The time on the dummy watches used by jewelers is the exact time when Abraham Lincoln was assassinated.

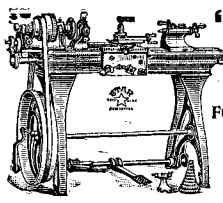
(9773) F. B. W. asks: Can you explain the phenomenon of the Aurora Borealis? A. We cannot explain the theory of the Aurora Borealis. The most we can do is to state the view held by the best scholars concerning it. To begin with, highly heated metals or carbon send out numerous minute particles with high velocities. These particles are called corpuscles, or electrons. They are known to carry charges of negative electricity, and to move with a very high velocity. It is reasonable to regard the sun and other stars at their enormous temperatures as sources of such particles, which move in mighty streams through the celestial spaces. When such particles strike a rarefied gas they render it luminous, as is seen in vacuum tubes. Such luminosity is associated with the discharge from the negative electrode of these tubes and has a name, —"cathode rays." In the upper air these corpuscles from the sun may well be considered to produce luminous effects, such as the auroral light. Arrhenius first suggested this theory of the aurora, but it is now quite generally adopted. Duncan's "New Knowledge," price $2, page 238, gives it in some detail. It is also to be found in Thomson's "Conduction of Electricity through Gases," price $4.

(9774) J. W. says: As a subscriber of your paper for a number of years, I take the liberty of asking a few questions in regard to the Corliss engine. First, what power would be developed with a 24 x 36 cylinder with 90 pounds steam pressure, speed 90 revolutions per minute? Also, 100 revolutions per minute; 115 revolutions per minute; 125 revolutions per minute? Same size cylinder and steam pressure to govern in each case. It has also been stated by one of our leading manufacturers in this city that the above engine equipped with an inertia shaft governor and double eccentric, running at a given speed per minute with 100 pounds steam pressure would develop 300 horse-power; while the same engine equipped with a double eccentric and an ordinary flyball Corliss governor would develop, with the same steam pressure and speed, 500 horse-power. To my mind this is absurd, but he is so positive, and a business man of some prominence, would you kindly give me your opinion? In other words, why should an ordinary Corliss governor give 200 horse-power more than an inertia shaft governor under the same conditions? What has the governor to do with the developing of power? A. The horse-power which an engine of any given size will develop at a given boiler pressure and speed will depend entirely upon the *point of cut-off*, or, in other words, upon the friction of the stroke during which steam is being admitted to the cylinder. It is possible to have the cut-off so early that the average pressure in the cylinder during the stroke will be nearly zero. On the other hand, it is possible to have the cut-off so late that the average pressure in the cylinder during the stroke will be approximateiy equal to the boiler pressure. The maximum economy with the Corliss engine is attained when the cut-off is about 30 or 35 per cent of the stroke; and the cut-off under maximum load should not be later than 40 per cent or 45 per cent of the stroke when an economical engine is desired. With cut-off at one-third of the stroke, the main effective pressure in the cylinder would be about 4-10 of the boiler pressure, or, in the instance that you mention, 36 pounds, and the horse-power at 90 revolutions would be

$$\frac{22 \times 24 \times 24 \times 36 \times 2 \times 36 \times 90}{7 \times 12 \times 3500} = 265 \text{ horse-power.}$$

At other speeds, the power would be in proportion to the speed; thus: At 100 revolutions, horse-power equals 294; at 115 revolutions, horse-power equals 339; at 125 revolutions, horse-power equals 368. At the steam pressure of 100 pounds, and the cut-off mentioned above, the horse-power would be 11 per cent greater. If the cut-off comes later in the stroke than estimated above, the mean effective pressure would be greater and the horse-power correspondingly greater. It is, therefore, perfectly possible that the statement made to you by the manufacturer to whom you refer is entirely correct. The range of cut-off with an inertia shaft governor is not nearly as great as the range which is possible with the ordinary flyball governor. The latter type of governor might easily permit a cut-off sufficiently late to allow the engine above mentioned, at a boiler pressure of 100 pounds and a speed of 100 revolutions per minute, to develop 500 horse-power. With this late cut-off, however, the engine would not be wroking with great economy.

(9775) E. E. asks: How is the focus of a concave lens determined? Is it the radius of a circle, or half the radius of the curvature? Please inform me as to both plano and double concave. A. All foci of concave lenses are virtual. For a biconcave lens of glass, whose index of refraction is 1.5, with the same radius of curvature on each face, the principal focal length is equal to the radius of curvature. For a plano-concave lens of the same glass, the principal focal length is equal to twice the radius of curvature. In these respects the concave and convex lenses agree, excepting that the focal length of concave lenses is negative. The formula for determining focal length of concave lenses is $\frac{1}{f} = \frac{1}{p} - \frac{1}{p'}$.



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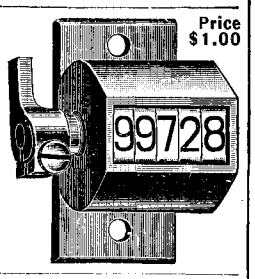

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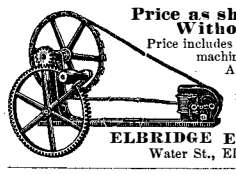

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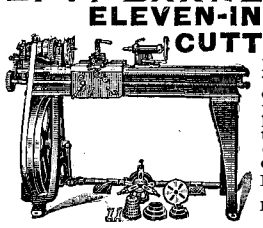

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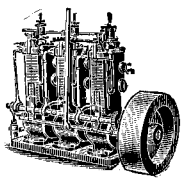

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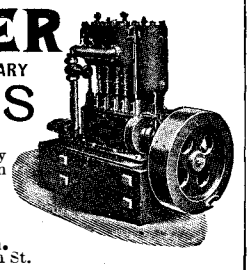

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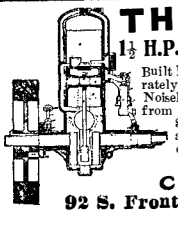

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THE STORY OF THE CONGO FREE STATE. By Henry Wellington Wack, F.R.G.S. New York and London: G. P. Putnam's Sons, 1905. 8vo.; 125 illustrations; pp. 643. Price, $3.50.

The present voluminous, but extremely interesting work is from the pen of an American who, as a student of mid-African affairs for the past seven years, and a close observer of the rapid progress toward complete civilization now being made in that part of the world, feels it to be his duty to lay before his countrymen the true and complete story of the conception, formation, and development of the Congo Free State. The motive prompting the writing of this book, which is of a character such as to have entailed much laborious and careful work, is to be found in the fact that during a period of several years there has been an organized campaign against the Congo Free State. The author, who is a Fellow of the Royal Geographical Society and a member of the New York bar, was in a position, because of a residence of several years in the United Kingdom, to observe the development of this movement. In the course of an interview with the King of the Belgians, the author frankly stated that he wished to have access to all the documents of the Congo administration office, for the purpose of writing an impartial book that would place the public in possession of the true facts regarding the affairs of the Congo. The King gave the author access to the offices of the Congo administration, where many weeks were spent in translating and copying documents. That the work is an impartial one may be judged from the fact that it is written by an outsider to the controversy, and that neither the manuscript nor the proofs were submitted to any person connected either directly or indirectly with King Leopold, the Congo Free State, or the Belgian government.

OUR STELLAR UNIVERSE. A ROAD-BOOK TO THE STARS. By Thomas Edward Heath. London: King, Sell & Olding, Ltd., 1905. Price, $2.

The author of this book, while converting for his own information the parallaxes of a long list of stars from seconds of arc to light-years, discovered a very suitable scale for stellar differences. After collecting all the information obtainable as to stellar parallaxes and magnitudes, he has written this small

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AND EACH BEARING THAT DATE

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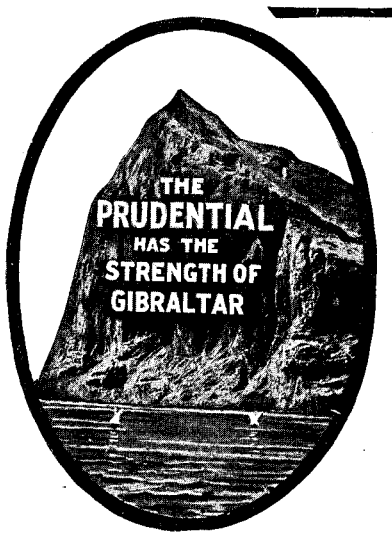

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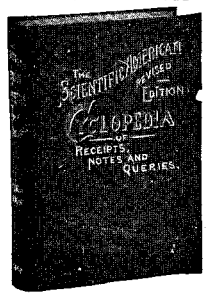

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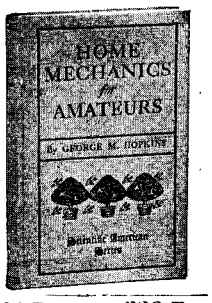

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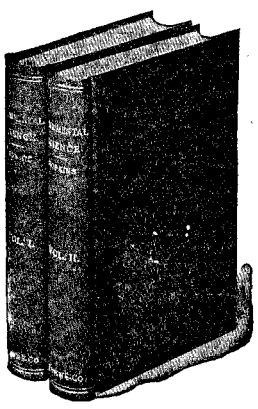

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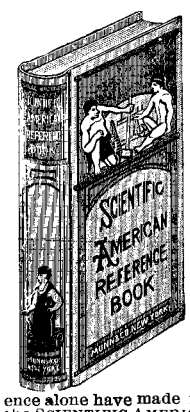

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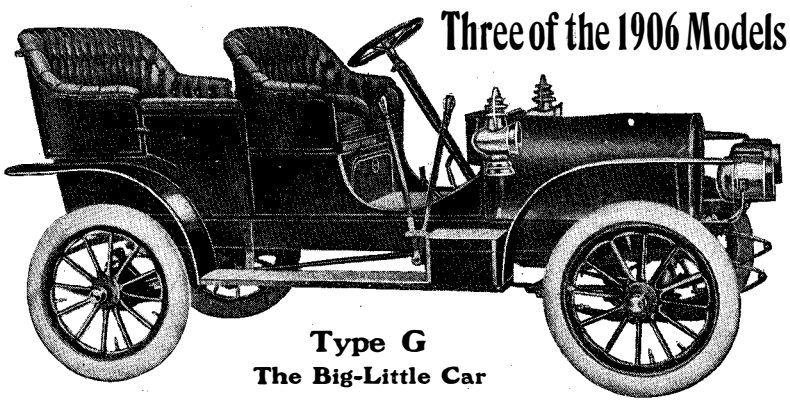

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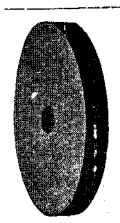

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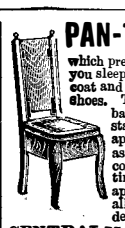

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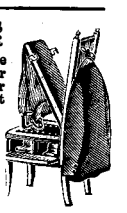

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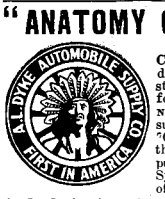

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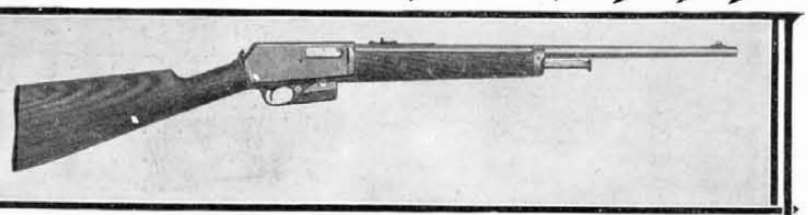

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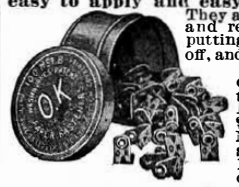

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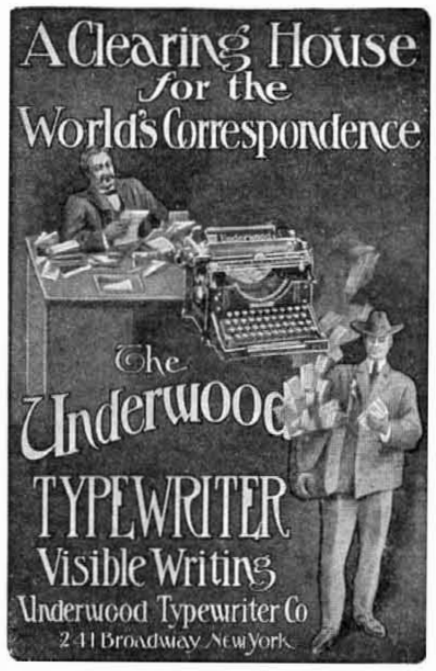

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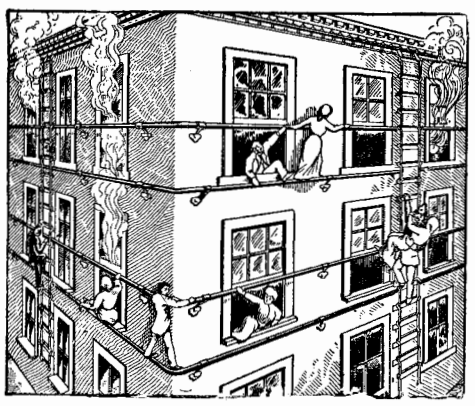

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Beds, Foster Bros. Mfg. Co	46,024
Beer, Hoster-Columbus Associated Breweries Co	45,970
Beer, lager, Lion Brewery of New York City	45,961
Beer, lager, Reymann Brewing Co	46,069
Belting for power transmission, Gandy Belting Co.	46,111, 46,112
Belting, leather, J. Meiers Sons	46,124
Bitters, stomach, Stein Brothers	45,999
Boots and shoes, Hamilton Brown Shoe Co	46,115
Boots and shoes, leather, A. H. Berry Shoe Co	46,074
Building block and tile molding machines, Besser Mfg. Co	46,060
Butter, J. G. Turnbull	46,007, 46,008, 46,071
Butter, vegetable, Nucoa Butter Co	46,067
Canned fruits, berries, and vegetables, H. C. Baxter & Bro	46,029
Canned fruits, vegetables, and blueberries, H. C. Baxter & Bro	46,030
Cards, playing, H. E. Gavitt	46,113
Carriages, sleigh attachment for baby, Kalamazoo Sled Co	46,032
Cartridges, Austin Cartridge Co	46,153
Cartridges, gun, Austin Cartridge Co.	46,151, 46,155, 46,156
Cement, portland, Alma Cement Company	46,014
Cement, portland, Atlas Portland Cement Co.	46,057, 46,058
Cereal paste goods, Lorenzo Bros. Macaroni Co	46,035
Chairs, Murphy Chair Co	46,130
Cigarettes, C. A. Van Rensselaer	46,013
Cigarettes, Stephano Bros	46,146
Cigars, Alles & Fisher	46,075, 46,076
Clay, clay mixture, and ground gannister, fire T. S. McRath	46,039
Clocks, New Haven Clock Co	46,132
Coffee, Sherman Brothers Co	46,046
Coloring and flavoring extracts, Palisade Manufacturing Co	46,068
Corsets, Kops Bros	46,033, 45,980 to 45,984
Corsets, corset waists, abdominal bands, etc., Wade Corset Co	46,073
Cosmetic cream, C. Frankham	46,108
Cotton domets and cotton and wool shaker flannels, Edson, Moore & Co	46,101
Cotton duck, Wellington, Sears & Co	46,167
Cream, washing, Melophine Co	46,125
Cultivators, Whitman & Barnes Manufacturing Co	46,165
Dentifrices, F. B. Shedd	46,144
Dynamite and powder, Rockdale Powder Co	46,142
Elastic arm bands, Blakesley Novelty Co	45,969
Electric conductors, Okonite Co	46,162
Erasers, rubber, Eagle Pencil Co	46,100
Fabrics and corduroys, corded cotton pile, W. Openhym & Sons	45,995
Fabrics, woolen, F. S. Mackenzie	46,121
Fasteners, snap, United States Fastener Co	46,072
Flavoring extracts, J. E. Fowler	46,025
Flavoring extracts, M. Michaelis & Sons	46,037
Flour, wheat, Eagle Roller Mill Co	46,022
Flour, wheat, New Athens Milling Co	46,131
Gin, Erdreich Bros. & Marx	45,957
Gin, W. H. Jones and Co	45,979
Glass chimneys, lantern globes, and reflectors, Gill Brothers Co	46,027
Glass, sheets of, J. C. Baird	46,015
Gloves, M. & C. Mayer	46,036
Greases, lubricating oils, and lubricants, Lubron Manufacturing Co	46,066
Gunpowder, smokeless, Austin Cartridge Co.	46,152
Guns and parts thereof, Hunter Arms Co.	46,160, 46,161
Hair dyes, C. Damschinsky	46,086
Hair pins De Long Hook & Eye Co	46,061, 46,062
Hair pins, Sterling Pin Co	46,070
Hams and bacon, Siegel, Cooper & Co	46,047
Harmonicas, mouth, Strauss Bros. & Co	46,051
Hats and caps, Eichhold & Miller Co	46,023
Heels and soles, elastic or cushion, F. W. Whitcher	46,170
Heels and soles, rubber, F. W. Whitcher	46,169
Hinges, spring, Bommer Brothers	46,080, 46,081
Hose, fabric, Eureka Fire Hose Co	46,105
Hose, hydraulic, Eureka Fire Hose Co	46,106
Incubators and brooders, G. H. Stahl	46,048
Inks, lithographing and printing, R. Mayer & Co	46,123
Insulating tubing, flexible, American Circular Loom Co	46,077
Iron, pig, Clinton Iron and Steel Co	46,017
Lenses, T. Mundorff	46,128, 46,129
Luster or varnish, Wadsworth, Howland & Co	46,166
Lye or potash, Eagle Lye Works	46,096
Mail matter handling machine, automatic, Agnew Auto Mailing Machine Co	46,056
Metal polish, W. J. Ladd	46,119
Milk, Orange County Milk Association	46,042
Miter cutting machines, Fox Typewriter Co	46,107
Mop wringers, White Mop Wringer Co	46,009
Needles, London Needle Co	46,034
Nozzles, bath sprays and jets, overhead showers, and hose sprinklers, rose, W. Boekel & Co	46,016

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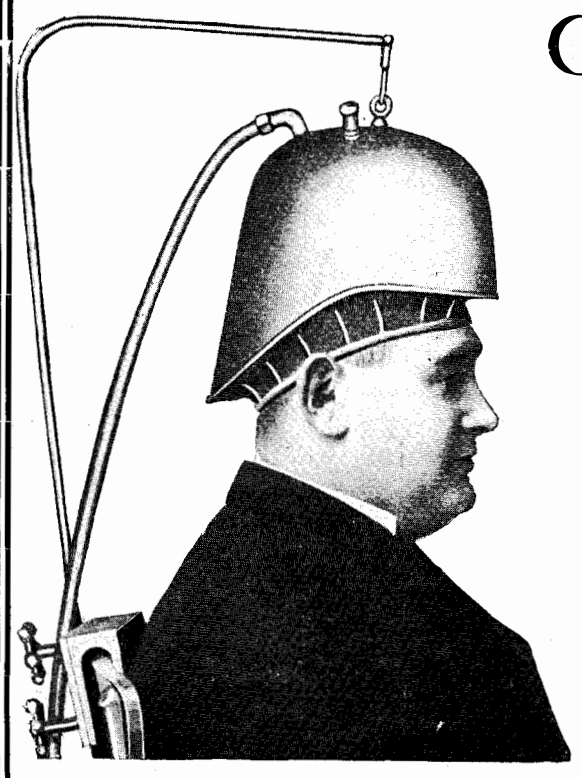

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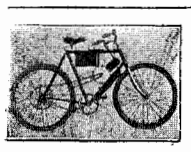

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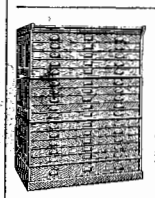

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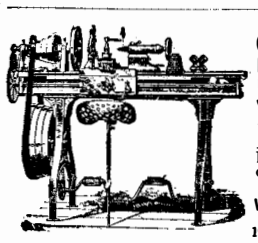

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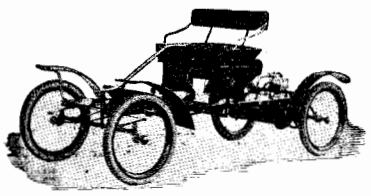

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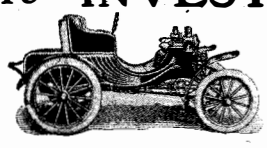

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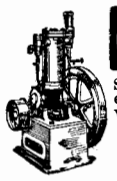

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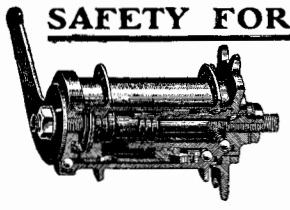

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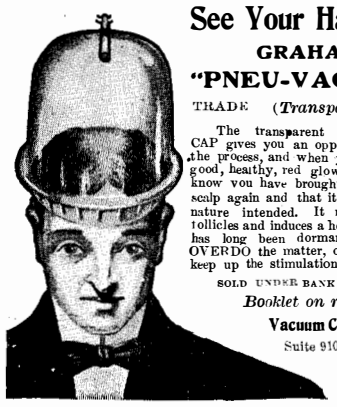

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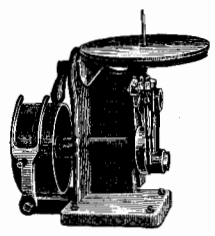

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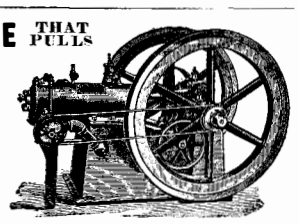

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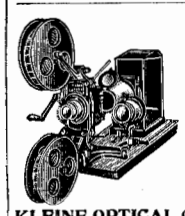

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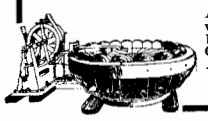

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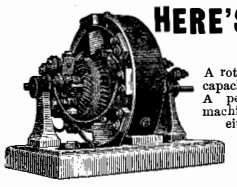

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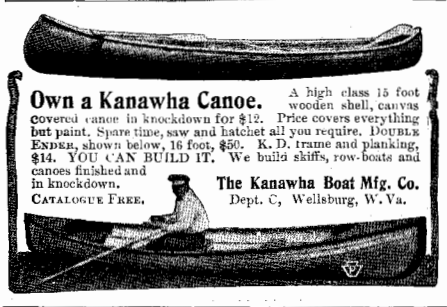

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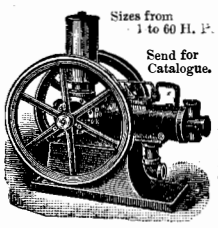

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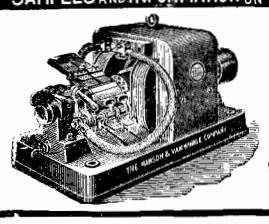

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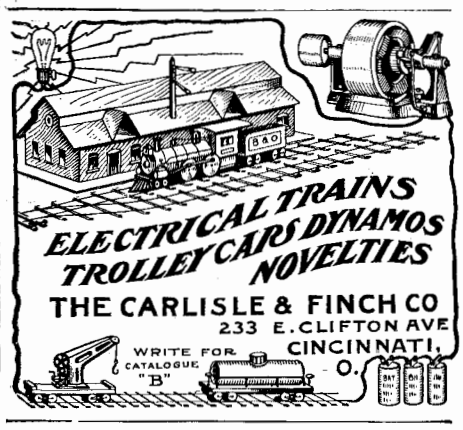

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